WORK

An Illustrated Magazine of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

[*All Rights reserved.*]

VOL. III.—No. 119.] SATURDAY, JUNE 27, 1891. [PRICE ONE PENNY.

A MODEL RUSTIC TOOL-HOUSE FOR A SMALL GARDEN.

BY ARTHUR YORKE.

MATERIALS—THE WALLS—THE ROOF—FITTINGS.

Materials.—In this miniature rustic building, the materials used are what are known as "slabs" or "rough planks." These are cheap, and have, when judiciously handled, a good picturesque effect. For those who do not know them, I may explain that these slabs are the outside slices, of which two are cut from every log of rough timber when it is sawn into boards. It is only our native trees which furnish them, imported timber being hewn square before it is sent to us. These slabs generally retain their bark (except in the case of oak), and in most districts they will commonly be of elm. Their thickness and outlines are necessarily irregular: one end will frequently be narrower than the other; and this will account for the arrangement seen in the walls and door of our building. They are to be bought at saw-mills, or wherever sawing is going forward; and as they are not looked upon as a marketable part of the timber, they are sold at a fire-wood price merely. Where their cost is not sensibly increased by carriage, no other material comes so cheaply for building rough sheds. The ordinary country way of using them is as in the horizontal section, Fig. 4.

Fig. 4.—Common Method of using Slabs.

This plan, however, is not suitable for our purpose. In so small a structure, rough planks on the inner side would too much interfere with our space. It is, therefore, proposed to straighten the edges, either by sawing or by chopping with the axe, according to circumstances, and lining their inner sides with thin board. If the cost be not objected to, half-inch match-boarding will be neatest for this purpose; if economy is an object, the boards of packing-boxes, bought from the grocer, might suffice. There are, it will be seen, three sides only to be lined.

Among a lot of rough planks, it is likely that stuff may be found sufficient for the posts and other scantling, but as this is uncertain, I have shown these matters as of regularly squared stuff. As to the six pilasters, which are added for appearance merely, it is possible that stuff might be found which would, when sawn to width, do for them; but I have rather supposed them to be fir poles or elm saplings; four sticks only are needed to supply the six halves and four quarters used.

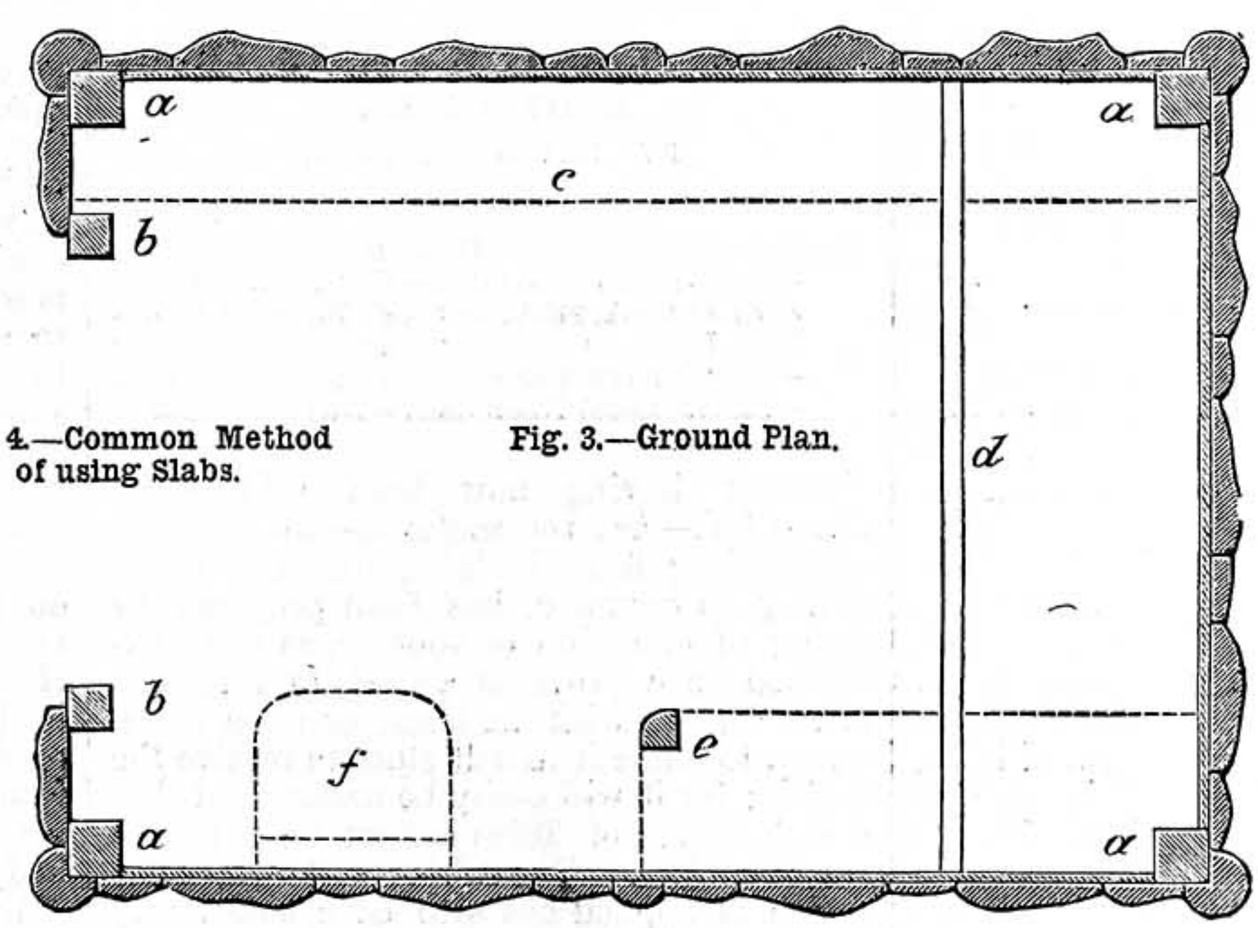


Fig. 3.—Ground Plan.

The Walls.—At the corners are four main posts, 4 in. square. These are shown at *a*, *a*, *a*, *a* in the ground plan, Fig. 3. These enclose (outside

Fig. 1.—Elevation of End.

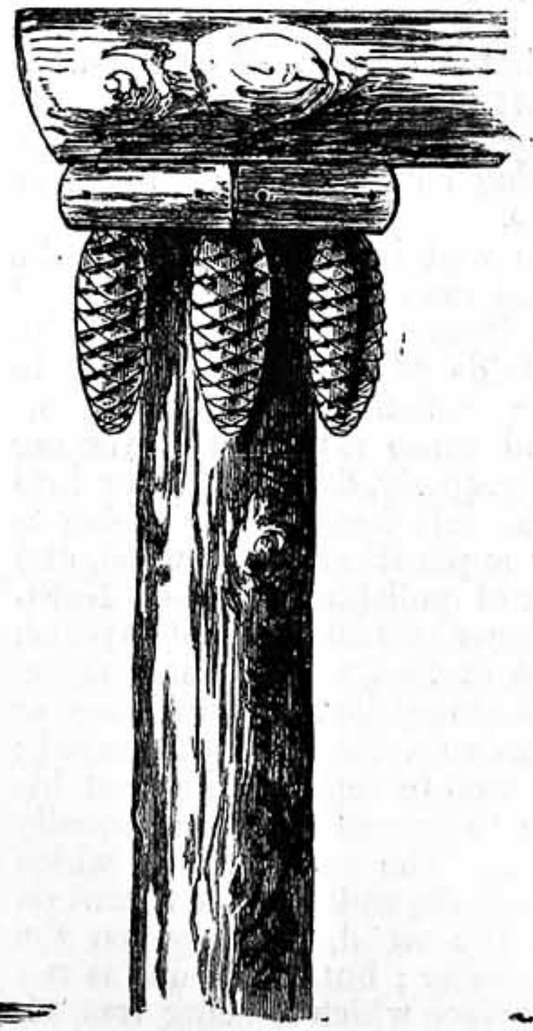


Fig. 5.—Cap of Pilaster (Enlarged).

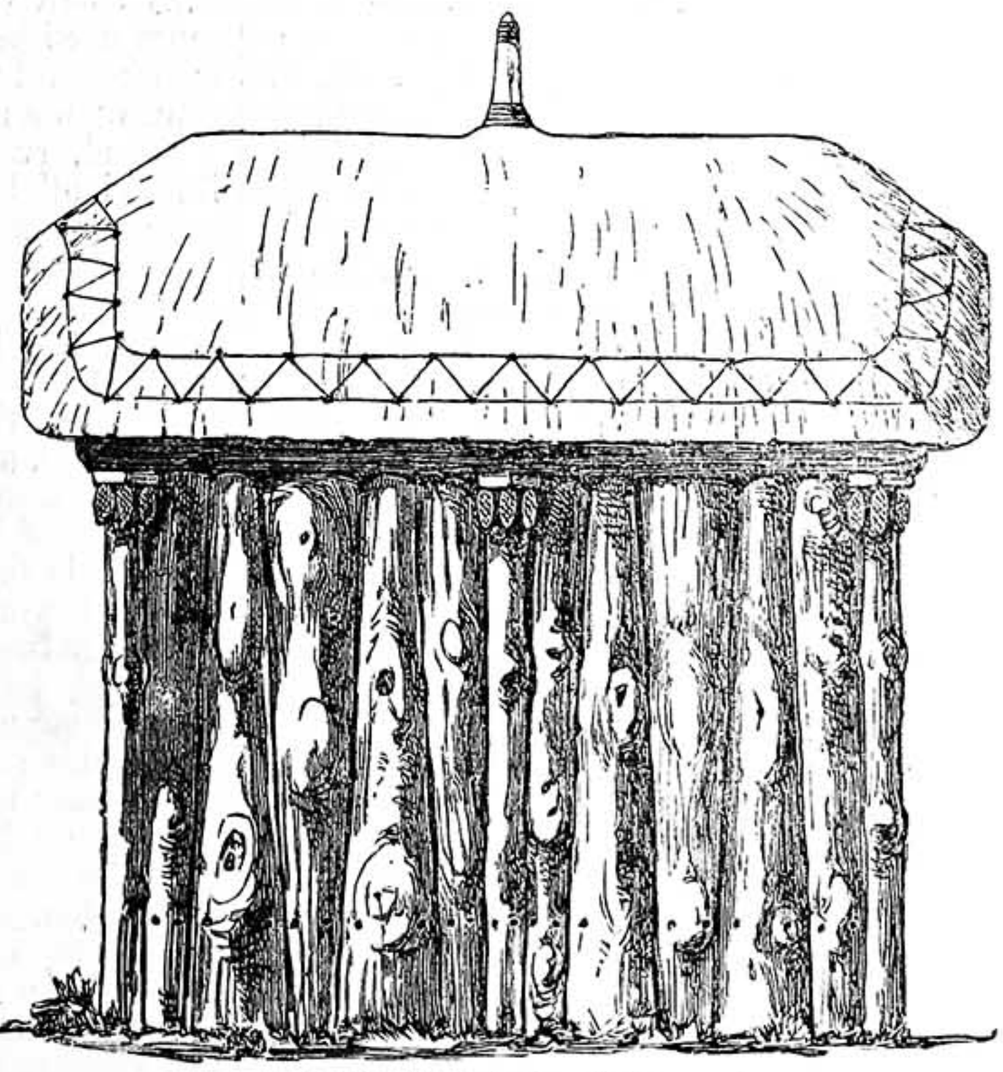
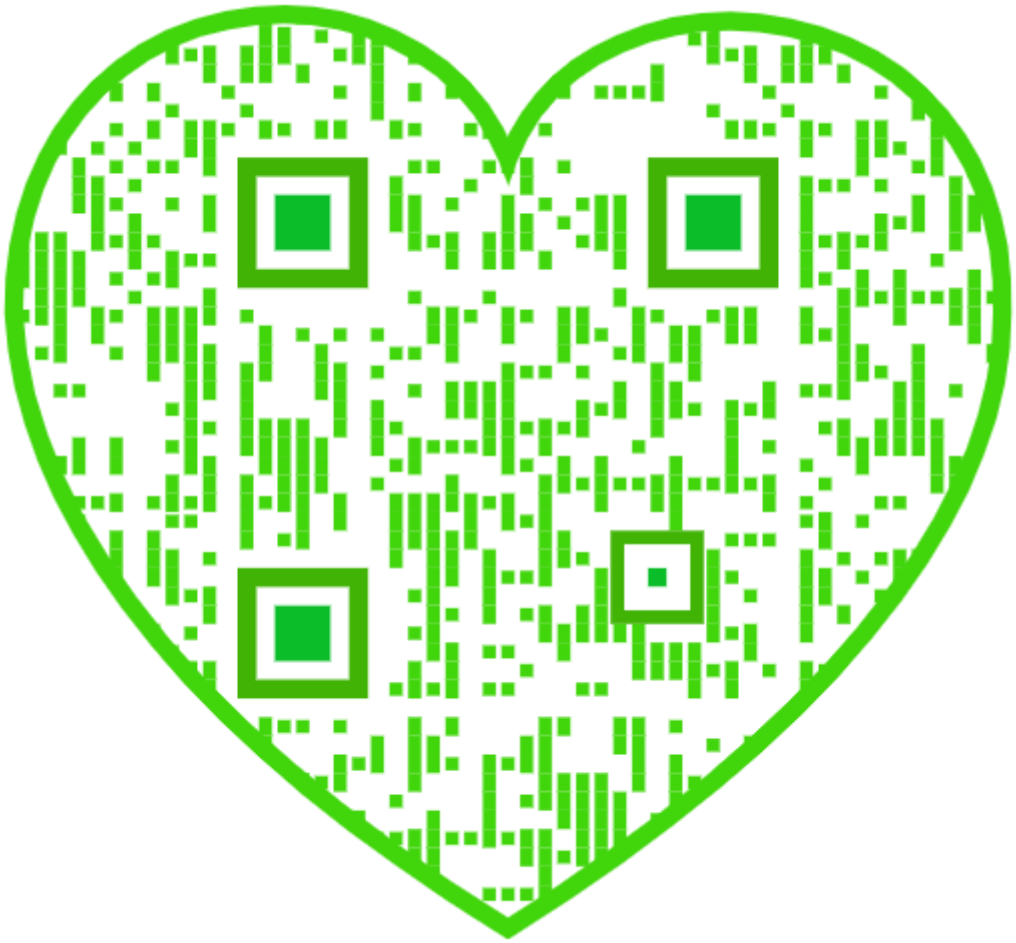


Fig. 2.—Elevation of Side.



measurement) a space of 7 ft. by 5 ft. They are let into the ground 2 ft., and rise 5 ft. 3 in. above the ground line.

On their tops, and coming flush with their outer edges, rest the wall-plates, which are 3 in. deep; these are needed at the back and sides only, and not at the front. On the same three sides will also be cross-rails, 2 in. to 3 in. thick, the ends of which will be let flush into the posts about a foot from the ground. To the wall-plates and these rails the slabs are nailed. In the side elevation, Fig. 2, the nails driven into the cross-rails appear, but not those driven into the wall-plate, a piece of rough stuff being there shown as fixed over the latter to support the eaves of the thatch.

To the front are to be seen the two door-posts, *b*, *b*, Fig. 3, which are 2 ft. 8 in. apart, and should be about 3 in. square. As their tops are nailed to the front pair of rafters, they rise to a height of 6 ft. 6 in. The space between door-post and corner-post is filled up by a single slab nailed to the two—5 ft. 6 in. long by 10 in. broad. Above these, instead of a wall-plate, comes the piece of strong slab, shown in Fig. 1 as having an opening cut in it for the head of the door. This is nailed against the door-posts, rafters, etc.

The pilasters are only a matter of ornament. As drawn, they are of halved stuff; the corner ones are so placed that their middles come opposite to the corners of the posts, on the other faces of which pieces of quartered stuff are nailed to meet them. The simple arrangement of the caps of these pilasters, with their decorations of fir cones, is shown on a larger scale in Fig. 5. The horizontal piece beneath the eaves, nailed over the slabs, has the effect of resting on the caps. Beneath the thatch at front and back corresponding pieces are fixed, those at the front being ornamented with fir cones nailed upon them.

The Roof.—This is shown in the elevations as thatched. No other covering will look so well, or be so thoroughly in keeping with other parts. The non-professional builder finds it easy to prepare for thatch, any rough stuff serving as rafters and laths, and no accuracy being needed in putting them together, since the thatcher, with his accommodating material, is able to make up any inequalities. The rafters for thatch should be arranged about 1 ft., the laths about 6 in., apart. In the article on Summer-Houses, Vol. II., page 67 (No. 57), it will be seen that more is said on the subject of thatch and thatching for rustic buildings.

Should there, however, be reasons for not employing this mode of covering, our building may be more quickly and easily, if not more cheaply, roofed with galvanised iron; only the gables will then best be made sharp instead of blunt, as at present.

Fittings.—Of these, the door should first be mentioned. Its outer slabs which appear in Fig. 1 are simply nailed to three ledgers of the same. Being of such rough materials, it will open better if hung on hooks and thimbles than on hinges.

As the space within will be strictly limited, we must take care that everything has its proper place—there is not room for confusion. The dotted line at *c*, Fig. 3, marks the projection of a set of shelves, about five in number, which fill the whole of the left-hand side. Of these, the lower will be for flower-pots, the upper for lines, setting-pins, trowels, etc. At *d* is shown a strip of wood fixed across the floor to hold the wheel of the barrow from running back when that useful vehicle is tilted up against the end wall, which will be the place assigned for it. In the gable and upper part of this end will be hooks or pegs on which to hang the riddle, watering-cans, and such matters. At *e* is an upright let into the ground, which, at the height of 2 ft., supports rails running to side and back; these form a kind of stand for spades, forks, and tools of that description. Above, against the wall-plate, may be more hooks or pegs.

It is suggested that at *f* a seat might be fixed to fold down like the leaf of a table when not wanted. As this building would form a snug shelter in a shower, such a seat would be a convenience; but the more important use of this space is that slightly below the level of the eaves it will be fitted with a rack for hoes, rakes, and similar implements. Such a rack is best made by boring ½ in. holes in a strip of wood at intervals of 3 in., and driving pegs into them 5 in. or 6 in. long. This has to be nailed so that the pegs will slope upwards, at an angle of about 45°. Rakes, etc., hung in a rack so made cannot fall.

Figs. 1 and 2 are ⅓ in. to the foot; Fig. 3 is ½ in. to the foot; but Figs. 4 and 5 are not drawn to scale.

FRENCH POLISHING—MORE ABOUT BODYING IN.

BY DAVID DENNING.

APPLIANCES NECESSARY—DESCRIPTION OF PROCESS—MOISTENING WADDING—TOUCHING RUBBER WITH OIL—APPLICATION OF MORE POLISH—HOW LONG TO CONTINUE FIRST BODYING IN—CONTINUATION OF PROCESS—SAND-PAPERING—CLEANLINESS NECESSARY—DRYING RUBBERS—EDGES.

ENOUGH having now been said about the polish—*i.e.*, the material—we may see about using it for bodying up. The wood, it may be assumed, has been prepared by filling of one kind or another, as fully explained in a previous article, and rubbed down smooth with the finest or worn glass-paper, to make it in a fit state to receive the polish; for it will easily be understood that a high degree of finish cannot be got on a rough surface. The rubber with which the polish is applied has also been sufficiently fully treated of elsewhere, so that nothing more need be said here about its preparation beyond that it consists of cotton wadding with a soft rag cover.

Wood, rubber, polish, and a little raw linseed oil being ready, bodying in may be proceeded with.

Moisten the wadding with some of the polish; put the rag cover on, being careful that at the bottom it is even and smooth, without any folds or wrinkles. Then, to distribute the polish evenly throughout the rubber, and cause it to moisten the rag at the bottom properly, dab the rubber into the palm of the left hand. The rubber is now ready for application to the wood, and the real work of polishing begins. Naturally, the beginner will not attempt to polish anything large at first, and it may, therefore, be supposed that he has got a piece of work which can conveniently be managed; and it may be well to remind him that his aim should be to spread the polish equally over the surface. The exact way in which this is done must depend to some extent on the shape of the wood, and also on the habit of the polisher; but, supposing it is a panel or flat surface which is being treated, the following method will be found as good as any, and is one that is more or less followed by experienced polishers.

Briskly rub across the grain, just to get the surface covered; then proceed by a series of circular movements, as shown in the diagram in page 54, to go over the whole of the work with a moderate amount of pressure, which should be gradually increased as the rubber dries, but at no time should the movement degenerate into mere scrubbing. In order that the rubber may work smoothly without sticking, its face should be just touched with a little of the raw linseed oil. The less of this used the better, and if it could be dispensed with altogether no harm would be done. Unfortunately, however, it cannot well be dispensed with, and the only thing is to use as little as can be managed with to make the rubber work smoothly. A very little will suffice. Just moisten the tip of a finger with oil, and touch the face of the rubber with it; that is all that is required. The rubber certainly must not be dipped in the oil, nor must the oil be dropped or poured on it from a bottle; for by any of these means more oil would be applied than is necessary—in fact, instead of being an assistance, the oil would prove fatal to good work.

As the rubber dries, more polish must be applied to it, as in the first instance, with oil as required. A very small quantity of polish goes a long way, and I must impress upon the novice the necessity of not making the rubber too wet. It should be fairly moist, and nothing more. Perhaps the best way to explain, to those who are unacquainted with the process altogether, what is wanted will be by comparing the rubber to a sponge, and illustrating what is wanted by means of this and water. Saturate the sponge with as much water as it will hold, and, supposing it to be a rubber with polish, it will be far too wet. Squeeze out some of the water till none drops from it if not squeezed, but leaving sufficient in to run out on the sponge being rubbed on anything hard. Still too wet for polishing purposes. Now squeeze all the water out till the sponge is almost dry, and will just damp anything on which it is rubbed without water flowing from it. This is just about what is wanted with the polishing rubber, and for ordinary bodying in it should never be wetter.

But, perhaps, many a beginner, noticing how tedious the work is with such a dry rubber, may be inclined to think that if he used more polish at a time the desired result would be more quickly attained. Well, if the object were merely to get the wood coated anyhow, this might be the case; but the result of using too much polish would be that, instead of a fine even coating or body, the shellac left by the evaporation of the spirit—and it is almost unnecessary to say that the spirit evaporates quickly—would be ridgy and irregular. Anything at all approaching a flow of polish from the rubber must be avoided. On the other hand, if the rubber is not sufficiently charged with polish, the labour of bodying up will be unduly protracted, if not rendered impossible, from the fact that no polish can be rubbed on to the wood.

The bodying in should be continued—that is to say, the first one—till it seems that the wood absorbs no more of the polish. There will be a perceptible gloss on its surface, but it will be streaky, and show the rubber-marks very distinctly. Never mind that, though, for all these marks will be removed later on—at least, let it be hoped so, for directions how will be given in due course.

It may be said that, if the polish is too

thick or too thin, the results will be very much the same as if the rubber were too wet or too dry. As it may be difficult for the novice to hit the happy medium, it may be as well for him to know that the principal objection to having the polish too thin is that it will take a longer time—*i.e*, more work to get a good body on the wood. It will, however, be better to run the risk of this than to have the polish too thick. An experienced polisher would soon detect any fault in either direction by the way in which the polish works, but it cannot be expected that the novice should do so. He must, therefore, be on the look-out for any irregularities in the shape of lumps or ridges which he may see, and, with a little attention, he will have no difficulty in avoiding serious mishaps.

Now, instead of hurrying on with the work, let it stand for at least a day, carefully covered up from dust; and on examining it again the body will be found to have sunk, but to what extent will depend upon circumstances. Any way, even the beginner will not fail to notice that it presents an altered appearance from that which it had when it was put away. This is owing to the polish having sunk into the wood, more or less. To compensate for this sinking, the work must be bodied up as before, always remembering to use as little oil as possible. The work will again be laid aside, and the bodying process be repeated till no more seems to sink in, even if the work is laid aside for a few days. When this stage is reached the bodying may be considered complete, and the work ready for the first polishing operations. Before proceeding to consider these, I have, however, to make some general remarks, which will enable the learner to work with more chance of success than if he were left alone, and told to glaze or spirit off. How to do these operations must be left for a future article, and meanwhile the novice will do well to note the following hints.

The number of times the work will require to be bodied up depends almost entirely on circumstances; but even for the best work, and that which is intended to be as durable as it can be, it need rarely exceed four. Fine, close-grained woods will not require so many as the more open kinds, such as oak, ash, mahogany, etc. Any reasonable interval—that is, one of several days—may elapse between the different bodies, the great object of waiting being to let them sink as much as they will. If, for example, after having laid the work aside for a few days, the polish has not sunk at all, no object would be gained by giving it another body, and so on with future bodyings. Of course, it is very seldom that the first body is enough. All the same, only one body is often applied in the trade, where either price or the limited time within which a job must be finished will not allow of more, so that cabinet-makers and others who may wish to do a bit of polishing must not suppose the process cannot be hurried.

Still, imperfect bodying is not advisable, as it will not be long before the work will want "touching up." Of course, if a job is like certain oft-referred-to razors, "made to sell," one body, and that of the slightest, is quite sufficient—from the seller's, if not from the buyer's, point of view.

Between the bodyings, especially after the first and second, the surface should be rubbed down with the finest glass-paper, not to such an extent as to rub all the body off, but just enough to smooth it. It may here be remarked that the pumice powder referred to in a previous article is, when used in moderation, useful for working down inequalities of surface. Although papering has been stated to be necessary after the first and second bodies, it must not be supposed that it may not be done after any others if they require it, which, however, they should not if the work has been skilfully done. In fact, as we shall see later on, the final bodying up may almost be regarded as the beginning of the spiriting off.

Before beginning to work a fresh body on a previous one, it is just as well to wash the surface gently with a little lukewarm water, and not too much of it, in order to remove the grease and allow the rubber to work freely. The water must be thoroughly dried up before applying the rubber, and, as is often the case, the washing may be omitted. In moderation, however, it can never do harm, and is generally an advantage, even though not absolutely necessary. When any long interval has elapsed the washing should never be omitted, as, of course, dust—otherwise "matter in the wrong place"—will settle on the work, and should not be rubbed into the polish.

Professional polishers should be careful to see that their hands are clean, or free from the old polish, which is so often seen on them, when doing any bodying up. If they are covered with the old polish or shellac, bits are apt to flake off and destroy the purity of the new work. Of course, this remark applies equally to amateurs and novices, but their hands are not so likely to have old polish sticking to them. As polishing is not altogether clean work, this may be an appropriate place to say that any polish which sticks to the hands—as some is sure to—may be washed away with hot water and soda, or with methylated spirit.

There may be some risk of novices supposing that a thick body is desirable: the opposite is the case, for it should be as thin as it can be. It is not so much the quantity of body on the wood as its quality that is required, and the way in which it has been applied, with sufficient intervals between the various bodies to allow of sinkage.

Another important matter is to dry the rubbers well out—that is to say, work them on each body till they are dry, and do not be continually moistening them. By this means the film of shellac is kept as thin as possible.

On no account should a wet rubber—or, I may say, one wet or dry—be allowed to stand on a surface while it is being polished. The rubber must be kept moving, and should, if I may so express it, glide gradually on to the work, instead of being plumped down on it. In the initial stages of bodying, care in this respect is not so important as later on, when it is absolutely necessary. The same degree of caution should be used when lifting the rubber from the work.

If it can be said that one portion of a piece of work requires more attention than another, it is towards the edges. On the "take care of the pence and the pounds will take care of themselves" principle, it may be laid down as a rule for the guidance of the beginner, that if he takes care of his edges the rest of the surface will look after itself. The reason is that the edges are apt to be somewhat neglected, and the polish to be less there than elsewhere.

With the remark that the secret of a good durable polish depends primarily on a good body, and this, in its turn, on sufficient time having been allowed for sinkage, my remarks on this part of my subject must be closed.

THE SAFETY BICYCLE: ITS PRACTICAL CONSTRUCTION, ETC.

BY A. S. P.

Building the Wheels.

Component Parts of Wheels—Spokes—Wheel to be Built—Dividing out Rim—Finding Length of Spokes—Fitting Oil Cup—Wiring One Side of Wheel—Wiring the Other Side—Determining Position of Chain-Cog—Loose Cone—Bottom Brackets—Direct Spoke-Wheel, why Described.

Our first practical work will be the building of the wheels. The wheels consist of hubs, spokes, rims, and tires, and there are various kinds of each of these. With regard to hubs, we have them of solid steel casting all in one piece; again, we have them of steel and gun-metal in combination, the steel parts being the two caps in the ends, which are hardened for the wear of the balls, and in the case of the rear hub the chain cog-wheel is also of hardened steel.

Spokes are of various kinds: as direct, butted, laced, and tangent. Direct spokes are those in which the wire is all of one thickness, screwed at the end next the hub; the hub being bored for them direct towards the centre, they enter the hub about ½ in. Butted spokes also enter the hub direct in the same way and to the same depth as the above, but the end of this spoke is thickened and screwed on this thick part. The spoke itself is usually No. 11 or 12, while the screw part at the end is No. 8. Common direct spokes usually snap just at the edge of the hub where the screwing has left off; it will, therefore, be apparent to anyone that a spoke thickened to nearly double at that part will be much stronger. I may mention that the Singer Company build nearly all their machines with butted spokes, and in all my experience in repairing their machines, I have hardly ever found a broken spoke. I have found numbers pulled right out of the hub, but never broken. Tangent spokes have their heads at the hub and the screwed ends at the rim, where nipples are used to tighten up the wheel. The hub flanges are made thin, and holes bored sideways for the spokes; the spokes are bent at the neck—that is, a little way behind the head—and passed through the flange towards the rim. Laced spokes again have two spokes in each length of wire; the flanges are made the same as the last, but the spokes have no heads whatever, they are simply laced through the flanges; the wire, being long enough for two spokes, is doubled in the middle, and the ends led away to the rim at more or less of a tangent; the ends are screwed and fitted with nipples as in the last case. Tangent and laced wheels have usually hollow rims, which allow the nipples to be sunk out of the way of the rubber tire. A wheel with a hollow rim is consequently dearer, the rim alone being four or five times dearer than an ordinary crescent rim.

The wheel we propose building for our Safety is of the simplest direct order with No. 10 spokes, headed at the rim. We will describe the building of one wheel, as the building of both is precisely the same. Say you have purchased a pair of hubs, tapped and plated ready for putting into your wheels. The rear hub should have not less than forty spoke-holes, and the front hub not less than thirty. A screw-plate should be provided to screw the spokes, same gauge as the hubs are tapped.

Say you purpose building the rear wheel. Find the number of holes in the hub, and

divide off the rim all round and equidistant for the same number of holes. Wheelmakers on a large scale have division rings for boring wheel rims any number of holes, but as our cycle-maker is not supposed to possess this appliance, he must measure off the rim with a pair of compasses. Take a piece of string and pass it round the hollow of the rim, and measure the exact length it takes to go round; reduce this length to inches, and divide by the number of spokes—say forty; the answer will be two, with a remainder; reduce the remainder to $\frac{1}{8}$ths and divide again, when you will get approximately the divisions of the spokes. Go round the rim in the hollow with the compasses or dividers, marking lightly with the points, first making a mark with a centre-punch to start from; count as you go round, and repeat the operation till the leg falls into the mark you started from; then centre-punch all the marks—forty—with the rim hanging on the nose of a high anvil, or across a leg vice when shut. Next bore with a drill one size larger than the spoke wire. If the boring is done with a lathe, let the rim rest on the lathe-bed at the right hand, and bore half the holes—that is, miss and take one—then turn the rim over and bore the other half; in this way the holes have an angle in the direction of the hub, and will appear somewhat ziz-zag on the inside of the rim. Care must be taken, however, to place the spokes in the proper holes when building the wheel. Having bored the rim, the next thing is to countersink the holes with a $\frac{1}{4}$ in. drill; this should be just sufficient to let the spoke head in flush.

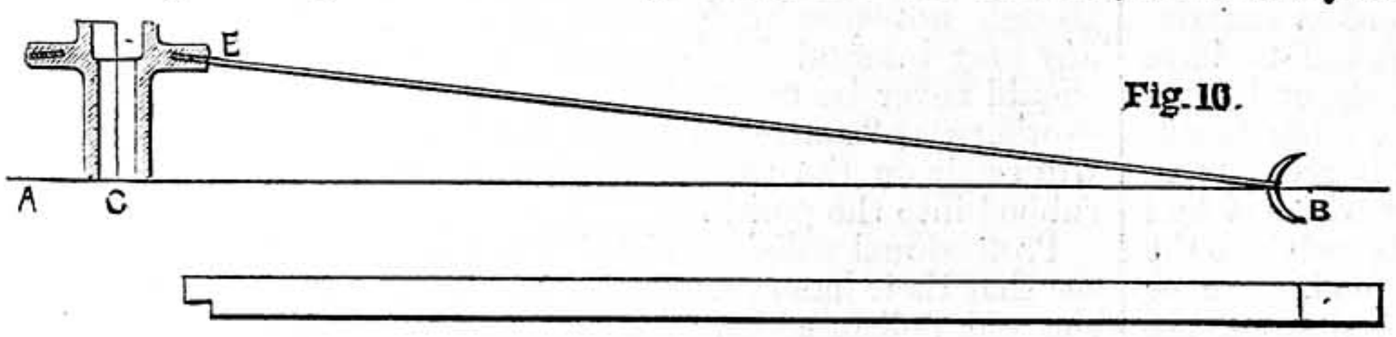


Fig. 10.

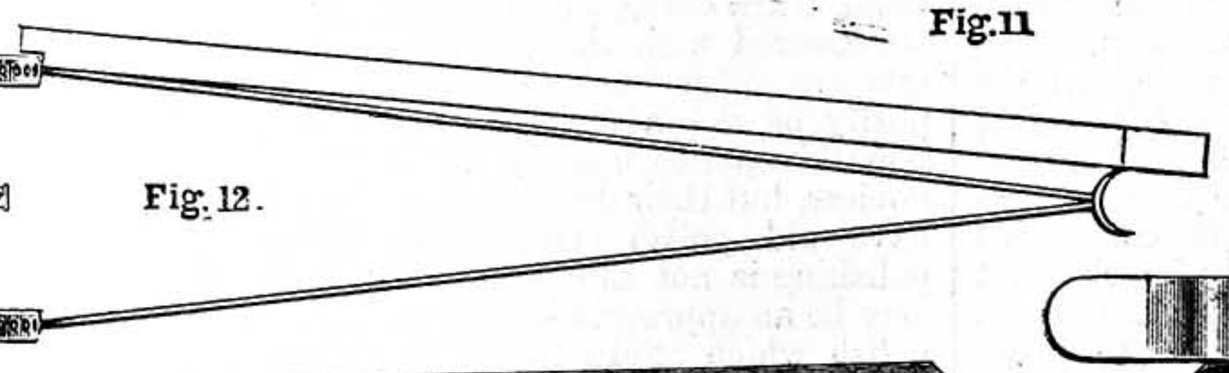


Fig. 11.

Fig. 12.

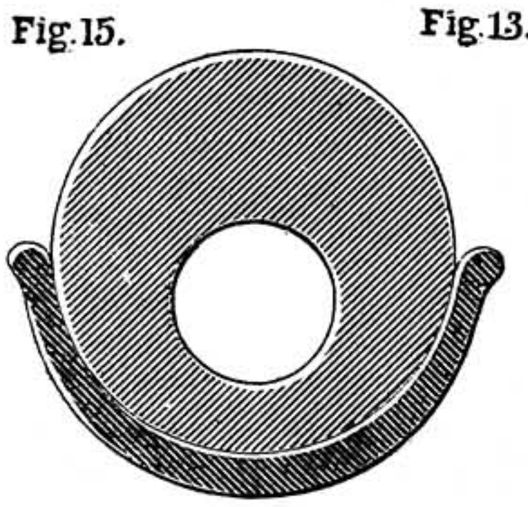


Fig. 15.

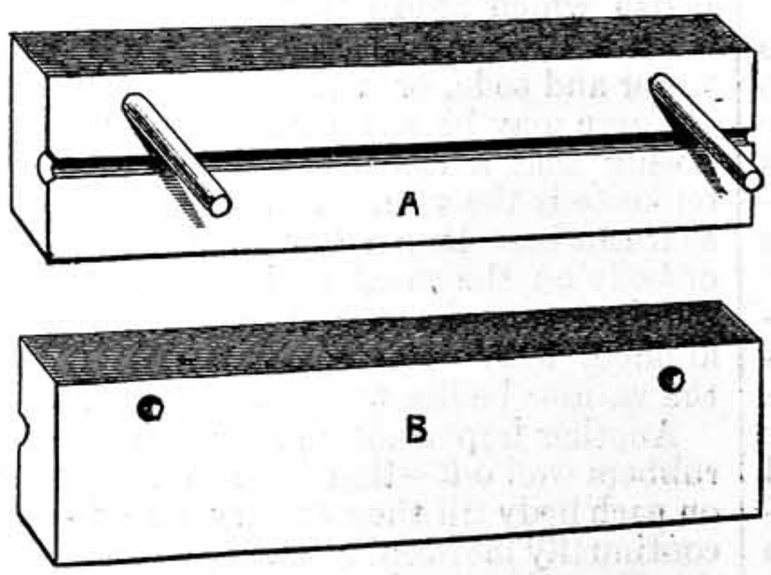


Fig. 13.

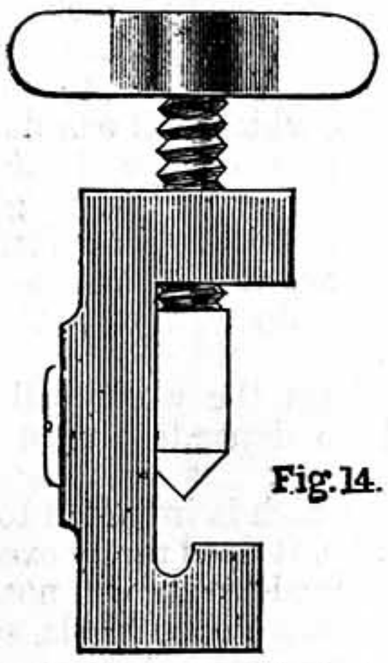


Fig. 14.

Fig. 10.—Mode of finding Length of Spokes (one-fourth size). Fig. 11.—Lath for truing Wheel (one-fourth size). Fig. 12.—Application of Lath (one-fourth size). Fig. 13.—Spoke Header (half size). Fig. 14.—Spoke Grip (full size). Fig. 15.—Cushion Tire (full size).

Now to find the true length of the spokes is an important matter, because if they are too long the wheel must come down again in order that they may be shortened. To find this true length, a drawing must be made, full size, similar to Fig. 10 here shown, which is one-fourth full size. Draw the line A B; on A B take a point C; at right angles to A B, at C, mark off half length of hub—that is, from centre of hub to the spoke-holes—and draw the half hub in section as shown: the spoke-holes should be drilled $\frac{5}{8}$ in. deep and tapped full length. Now measure exactly the diameter inside of the rim; take half this diameter, and mark the section of the crescent rim from C towards B. Next draw the line B E, which will be the length of the spoke, less the part that enters the flange, which should be not less than $\frac{1}{3}$ in. The spokes should all be cut exactly the same length, and screwed a little less than $\frac{1}{2}$ in.—say, $\frac{7}{16}$ in.; in screwing, find how many turns of the plate will do $\frac{7}{16}$ in., and give all the spokes the same number of turns. Now the holes in the hub flanges should have $\frac{1}{16}$ in. bored plain without screwing, and the full size of the wire, so that on building the wheel the screwed part will go out of sight in the flange. The spoke is in this way a little less liable to break off level with the flange, and when it does break off, it is at the end of the screwing and a little within the level of the flange, leaving a good recess for boring out the stump.

The next step before beginning to put up the wheel is to fit the oil cup, and leave it in its place. Now try a spoke in the hub, and screw it home; see that it is not too stiff to screw up, nor too easily screwed up; it should screw home with the spoke-grip without forcing, and it should not be so easy as to screw home with the fingers and without the use of the grip. Be sure that all the spoke-holes in the hub are properly cleaned out and properly tapped. Now to put the wheel together, place the rim on three or four bits of wood about 2 in. thick on the bench, stand the hub in the centre, and pass all the spokes for one side through, entering them in the hub a little way with the fingers only; of course, you will take and miss a hole in the rim, and notice at the same time the ziz-zag holes in the rim, and pass the wires through the holes that look upwards to the upper end of the hub. This, of course, will be at once clear to anyone performing the operation.

Having put in all the wires for one side, turn the wheel over and put in the other half. Now screw up the whole of the spokes with the grip till the screwed ends just disappear in the flange. Now to true the wheel, take a thin flat rod of metal, or a thin lath of wood, and make a notch at one end, as in Fig. 11; this notch rests against the flange, as in Fig. 12. Make a mark with a pencil on the lath where the sharp outer edge of the rim touches it; now apply the lath between the spokes all round the wheel on both sides, and observe where the edge of the rim falls within or without the pencil mark; this shows where to screw up and where to let down. This, I believe, is not exactly the method used by wheelmakers, but as I am a self-taught cycle-maker, I have to resort to my own methods, and I find the lath as above described to be very serviceable, as I have frequently put up wheels with it that ran dead true the first trial on their own spindle. I have, however, often found rims with a high edge and a low one, which destroys the true working of the lath as a gauge, and throws the hub out of centre—that is, gives the wheel more dish on one side than the other, which is to be avoided above all things. But assuming the rim to be truly made, and the hub flanges to be both the same diameter, if the rim all round on both sides touches the mark on the gauge, you may rely on the wheel running true on its spindle when tried; radially, it will be dead true, and if there is any side-wobble, touch it with a bit of chalk while revolving on its own spindle, and twang the spokes on the side with the chalk; if they sound tight let them down, say half a turn, and tighten up those on the opposite side, say half a turn. Try the wheel again, and any part, however little off the truth, will show with the chalk. It must be understood that a very slight tightening or slackening of a spoke makes a perceptible alteration on a wheel. One important thing to observe before the wheel can be said to be finished, is to see that all the spokes are of the same tension; this can readily be ascertained by twanging with the fingers. If they are all of one tension they will all give forth the same sound or note, being all of the same length.

Now, having finished this wheel ready for the tire, the other wheel is treated in exactly the same way, only you must see that the hub and rim are of the same diameter as the last, else you will have to make a new drawing to find the true length of spokes, or if using the same drawing, make allowance for the difference.

Now, with regard to the rear or driving wheel, you have got to determine on which side of the machine you will have the chain-cog, whether right or left; sometimes the make of the hub determines this, as the spindle having a fast and loose cone, the loose cone should always be on the *left* side of the wheel in running forward, for the reason that a loose cone is apt to turn on the spindle with the friction of the balls, especially when dry. Now, if the cone is on the right side, and turns on its spindle, the result is that it winds further *on* the spindle and jams in the hub, stopping the wheel; but if placed on the left side it turns on its spindle, winds off towards the fork side, and cannot jam the wheel, which is a lesser evil; of course, if the wheel is kept properly

adjusted and the outside nuts well up, the cone cannot run either way. Some makers of hubs, however, have both the cones loose; in this case the nuts must be kept well up, or the right cone will be sure to run in and jam the balls, stopping the wheel.

This rule with regard to the loose cone must be observed the same with the front wheel as with the back.

With regard to many of the bottom brackets in use the same rule holds good, as the pedal shaft has a fast and loose cone, with the chain-wheel keyed on immediately behind the fast cone. In this case the chain-wheel and chain should always be on the *right* side of the machine, which places the loose cone on the *left*, where it should be. I have handled many machines, however, where this rule was disregarded. In our bottom bracket, however, the two bearings are separate, being the same as those used on an ordinary bicycle, consequently we can fix our chain-wheel on either side.

I have, in this paper, described a plain direct spoke wheel on account of the difficulty of building one with butted spokes in the absence of a spoke heading machine, which costs between £4 and £5. A butted spoke being No. 14, and the butt end No. 8, the rim is bored with a No. 13 drill, so it will be readily seen the butted end will not pass through the rim; for this reason butted spokes have no heads, and are passed through the rim from the inside and a head worked on after the spoke is in the rim, hence the need of a heading machine. In the absence of a heading machine, I use a very simple contrivance which does the work fairly well. It is illustrated in Fig. 13, A, B, and consists of two steel plates, 4 in. long, 2 in. broad, and $\frac{1}{2}$ in. thick. Plate A has two $\frac{3}{8}$ in. round steel pins fixed into it; plate B has two holes to receive these pins, and the two plates when shut are flush all round with each other. Along the centre of both plates a shallow V-shaped groove is made, both grooves together being a little less than the thickness of a spoke. When the two plates are firmly caught together, a counter-sink is made at one end where the grooves terminate; this counter-sink is the recess to form the spoke head (see A in Fig. 13). To use this tool, the spoke is caught between the two plates in the grooves, about $\frac{3}{16}$ in. protruding beyond the plates at the counter-sink end. In this position it is caught in a strong vice, and the head formed by hammering the projection into the counter-sink; of course, the spoke has been passed previously through the rim. In building a new wheel, all the spokes would be cut the proper length, butt ends screwed, then passed through the rim and headed, after which the wheel would be built as described in the earlier part of this chapter. The spoke grip referred to in this chapter is illustrated in Fig. 14, and may be bought for 1s. 6d. Before closing this paper, I deem it advisable to say a word regarding cushion tires, which are the rage just now, it being just possible that our cycle builder may not be content with the $\frac{3}{4}$ in. crescent rim and solid tire herein described. If he purposes having a cushioned-tire machine, the tire should not be less than $1\frac{1}{4}$ in. diameter. A tire of that sort is shown in Fig. 15, with a section of the rim used, or ought to be used, with it, the edges being turned out and blunted or beaded to prevent cutting the rubber. The hole in this tire is $\frac{1}{2}$ in., and, as will be noticed, is not central, but a little nearer the rim. Rims of this sort can be had, as well as hollow rims, formed on the rubber side in the same way, of Thomas Warwick's make.

It must be borne in mind that a $1\frac{1}{4}$ in. tire requires a wider fork to let it pass through, also a broader spoon for the break, as well as broader mud-guards. Our next work in cycle building will be at the lathe and fitter's vice.

AN IMPROVED PIN-STOP BENCH-BLOCK.

BY J. BLACKMORE WILLIAMS.

Those workmen familiar with the common work-bench used by joiners, cabinet-makers, etc., are, I venture to state, well aware of the fact that the present bench-block mostly in use consumes a vast amount of time in adjusting, and the amount of labour required in, say, a year's time, where there are a number of workmen employed in shops and other places, is something enormous, to say nothing of the constant change of position, as the workman has usually to go round the corner of his bench to knock the block into the position he desires. The bench I use is for convenience pushed up against a wall, from which is suspended a woodrack, and in adjusting my bench-block I invariably experienced a great difficulty, which I remedied in the following manner:—

I sawed out of the end of the bench a piece, 10 in. by 2 in., and cut from the screw to the end of the bench-board on a slant, as shown in Fig. 1. I then procured an iron plate, perforated with small holes at intervals of $\frac{1}{2}$ in., and grooved at the sides (as shown in plan and section at A and B, Fig. 3) for the reception of another plate, $2\frac{1}{2}$ in. by 2 in., as shown at F. On to the latter plate, which

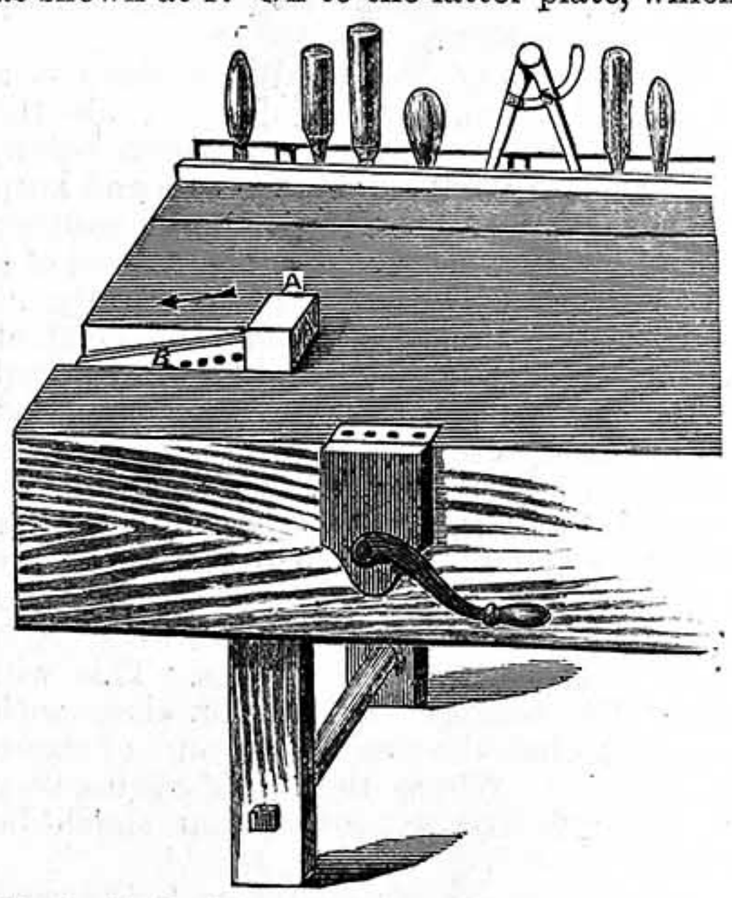


Fig. 1.—End of Bench fitted with Williams' Bench-Stop, showing Stop at $1\frac{1}{2}$ in. greatest height.

was $\frac{1}{4}$ in. in thickness, I screwed from the underside of the plate my pin-stop bench-block, which must be cut on the level at the bottom, and so arranged for height that when it reaches the end of the bench, as in Fig. 2, it is perfectly level with the face of the bench. Fig. 1 will clearly show the reader the appearance of the block when adjusted, A being the bench-block, and B the bevelled groove, perforated with holes for the reception of the stop-pin, as shown at C in Fig. 3. At D is shown the $2\frac{1}{2}$ in. by 2 in. plate with screw-holes, for fastening the wood bench-block, and E shows the bench-block when screwed on to the plate. At F is shown the bench-block complete. A and B, in Fig. 3, illustrate the permanent plate, B showing the manner in which the grooves are formed for securely holding the bench-block. The workman will readily see from the design the manner in which the block is raised or lowered by pushing it along the permanent plate; and on getting the desired height, he drops the stop-pin into one of the holes nearest the back of the bench-block. Some objection may be raised by workmen on the ground that when the block is at the end of the bench there is a cavity into which, say, an

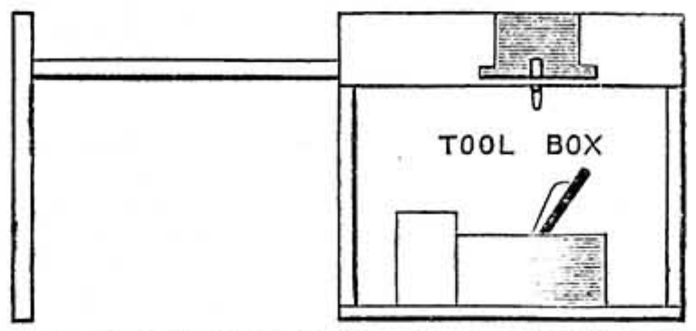


Fig. 2.—End Section of Bench, showing Pin-Stop Block at lowest height.

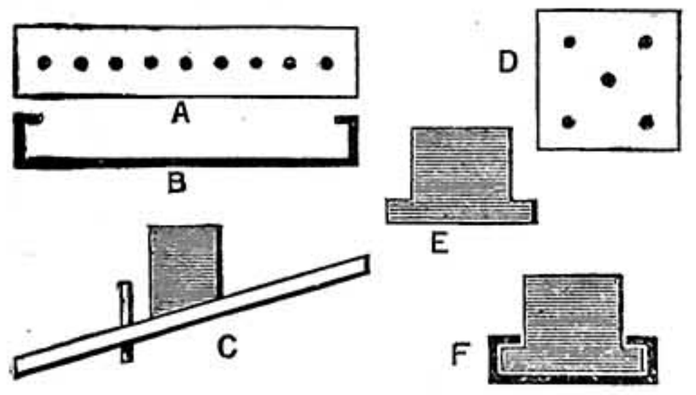


Fig. 3.—Parts of Pin-Stop Block—A, Iron Plate pierced for Pin in Plan; B, Plate in Section; C, Pin and Block.

inch board, in being shot, would fall in; but he will readily remedy this by letting in a slot-piece, fitted level with the face of the bench. Of this fact, there is no doubt that those workmen who adopt this inexpensive improvement will not only save a vast amount of time, but they will be able to adjust it without moving from the screw. I had at first thought to arrange a slot movement, but thinking of the quantity of sawdust which would tend to choke the cogs, I decided on the pin-stop, which leaves the permanent plate clear, and may be fastened to the bench by means of a small chain.

ENGINE AND BOILER MANAGEMENT.

BY M. POWIS BALE, M.INST.M.E., A.M.INST.C.E.,

Author of "A Handbook for Steam Users," "Wood-working Machinery," "Stone-working Machinery," "Pumps and Pumping," etc.

Rules for Engine Drivers and Boiler Attendants.

Filling Boiler—Examining Water-Gauge and Test-Cocks — Cleaning Tubes — Lighting Fire—Examining Safety-Valves—Lubrication, etc.—Examining Bearings—Raising Steam Slowly—Regular Admission of Feed-Water—Examining Height of Water in Boiler — Starting Engine — Surplus of Steam—Testing Safety-Valves and Pressure-Gauges—How to Test Pump—In Case of Low Water—In Case of Safety-Valves Sticking—Priming—Examining and Testing Steam Exhaust.

Owing to the multiplicity of types of engines and boilers in use, it is difficult to draw up a code of rules in which the wording will apply equally well in all cases. The *principles*, however, embodied in the following rules may be generally applied,

although the phraseology may sometimes require slight modification.

1. *Filling the Boiler.*—Fill the boiler with water till it rises to the mark on the gauge which shows the water line. If there is no water line marked, fill till the gauge glass is about three-quarters full.

2. *Examine Water-Gauge and Test-Cocks.*—Open all the water-gauge and test-cocks, and see that they are in order. If the water does not enter the gauge glass freely, it must be unscrewed and a piece of wire passed through the openings in the boiler.

3. *Cleaning Tubes, etc.*—Remove all soot from the tubes, and clear the fire-bars and ash-pit of clinkers and ashes. If the flues are dirty, have them swept.

4. *Lighting the Fire.*—Light the fire, which should be kept bright and even, and of a thickness of about 4 in. to 6 in. in tubular boilers, and from 9 in. to 12 in. in Cornish or Lancashire boilers, except when there is a surplus of steam, when a thicker fire may be used. The thickness of the fire should be regulated by the nature of the fuel. Should the draught be bad from dampness, direction of wind, or other cause, a temporary artificial draught may be made by lighting some shavings in the smoke-box or chimney.

5. *Examine Safety-Valves.*—As the fire burns up examine the safety-valve, and see that it moves freely in its seat. Examine float or low-water alarm if one is fitted.

6. *Lubrication, etc.*—Fill the lubricators. A little fine powdered plumbago or asbestos may be added with advantage, especially to the cylinder lubricator. The use of the best quality of oil or grease is to be recommended. What is required is a neutral grease that will not develop free or fatty acids under the action of steam. Its melting point should be low, so that it will liquefy with a small amount of heat, and yet it should retain sufficient body, that it will not readily run from the bearing surfaces. Lubricate piston rod and guides. Examine eccentric, and see that the key is tight and the lead of the valve has not been accidentally altered.

7. *Examine the Bearings.*—Examine systematically and screw up the bearings of the engine, not too tightly; this is best done, if required, immediately after finishing work for the day, as they are then expanded from the friction of working and are in their running condition. If bearings are tightened in the morning before commencing work, which is usually the plan, they are cold, and therefore contracted. If a bearing get hot, cool with water and scrape off all scored or rough places; if it knock in working, let the faces of the bearing be slightly closer together. Lubricate well with a mixture of grease or oil and powdered plumbago, say three of grease to one of plumbago. If the bearing be large and subject to great strain or pressure, the proportion of plumbago may be increased. Replenish all lubricators before starting work, and guard all bearings as much as possible from dust. If there is undue friction on the bearings, particles of metal will be found in the oil after using if it is spread on white paper.

8. *Raise Steam Slowly.*—Always raise steam slowly and avoid forcing the fire, as this causes uneven expansion and strains and damages the seams and boiler plates. Keep an even pressure of steam, but not one that has to blow to waste through the safety-valve.

9. *Regular Admission of Feed-Water.*—Hot feed-water is in every way to be preferred to cold; but if cold is used, do not admit it into the boiler in large quantities at a time. Keep the pump working regularly, but with the admission valve only partly open. We recommend the use of a feed-water heater, but if one is not fitted, direct the exhaust steam into the water-tank, say a quarter of an hour after starting, as by that time any accumulated grease from the cylinder may have blown away.

10. *Examine Height of Water in Boiler.*—Examine height of water frequently during the day, and try gauge and test-cocks and float. Blow-out and scum taps should be opened once a day at least, oftener if the water is bad. Be sure that the float is acting properly, as it is apt to stick, especially if of very light construction. The water-level in Cornish or Lancashire boilers above the surface of the flue should never be below 4 in. in depth under any circumstances, and a working level of about 9 in. will generally be found most suitable. In finishing work at night leave a full supply of water, in case of leakage or frost.

11. *Starting the Engine.* — Supposing steam to be up to the working pressure, the safety-valve having been tested at intermediate points, turn the fly-wheel of the engine till the crank shaft is at half-centre. Before starting, let the engine cylinder be thoroughly warmed; this is especially advisable with large engines or in frosty weather. Now open the cylinder cocks and turn on the starting lever or valve gradually to about one-third of its traverse. Steam now enters the cylinder, and the engine is set in motion. When no more water is expelled from the cylinder, close the cocks. See that there is no leakage of steam from the piston-rod packings or any of the joints. Allow the bearings of a new engine to be a little slack for a time. Never start or stop an engine suddenly.

12. *Surplus of Steam.*—When there is a surplus of steam, close the damper, rake the fire-bars so as to admit the air from below, open the ashpan lid if there is one, and keep the furnace door closed. (N.B.—The author recommends, wherever possible, the use of a damper worked by steam automatically, as it is certain in its action and independent of the boiler attendant. It can be arranged to act at any desired pressure of steam, and effects an appreciable saving in fuel. It is important, whatever form of automatic damper is used, that it is arranged with a sensitive action. This may be secured by hanging the damper on a steel-pointed screw pin, and making the working parts with steel centres and V edges. This will allow the damper to open or close with rapidity when the desired pressure of steam is reached.) Where the work varies very much, automatic expansion gear should be fitted.

13. *Testing Safety-Valves and Pressure-Gauges.*—Test the safety-valve at least twice a day; if about $\frac{1}{8}$ in. to $\frac{1}{4}$ in. of space is shown between the valve and its seat for the escape of steam, this is usually sufficient if the valve is of proper area for the boiler, but some valves are arranged to lift less than this. Pressure-gauges should also be occasionally tested by shutting off the steam and letting the pointer run back to zero; for this purpose the cock to the gauge should be arranged to open to the atmosphere when shut off from the boiler. Check also the safety-valve against the pressure-gauge by altering the former to blow off at whatever pressure is at that time shown on the pressure-gauge. If they do not agree, have the gauge tested by a standard one. See that the figures on the pressure-gauge are large and plainly marked, so that they may easily be read at some distance away. It is also best to distinguish the average or safe working pressure of the boiler by a red line on the gauge; this can readily be reduced as the boiler deteriorates. If the pressure-gauge shows the blowing-off point, and the safety-valve is found to be stuck or inoperative from any cause, start the feed-pump, close the damper, and open the furnace door. Start the engine should it be standing, and let the fire out or draw it when the pressure is reduced. Never under any circumstances wedge down or overweight a safety-valve, and "wire-drawing" the steam should not be resorted to. Should the valve leak at all, have it reground at once and made perfectly steam-tight.

14. *How to Test the Pump.*—Test the pump occasionally by opening the waste-tap; if no water is expelled the pump is not working, either from there not being a vacuum, the packing or joints being out of order, the valves choked with dirt, or the pump hot. Before taking it to pieces place your hand tightly on the end of the waste-pipe, allowing the air to be discharged from the pump by the inward stroke of the plunger, but not allowing any air to re-enter during the outward stroke. If this has the desired effect in setting the pump to work, close the waste-tap, and the water will be forced into the boiler. If the pump gets hot, pour cold water on it. If hot water continually issues from the waste-cock, the probability is the check-valve nearest the boiler is choked. In this case the steam must be blown off and the fire put out, the valve-box cover must be taken off, and the dirt or obstruction that prevents the valve acting removed. If the suction or delivery valves are choked, hot water will not pass through the waste-cock; these valves may be examined when the engine is working, but should the defect not even then be discovered, the suction-valves, delivery-valves, and the packing of the plunger must be examined and the packing renewed, as the pump is probably drawing air; screw up and clean the union nut of the suction pipe, and make another trial. Occasionally a valve that has stuck may be released by a few sharp blows of a hammer on the outside of the clack cover. If a pump plunger is worn it will not act, at any rate satisfactorily, and should be seen to. In case it is necessary to take the pump to pieces, should there be no check-valve fitted or it be choked, be sure that the water stop-valve is closed, or the boiler may be drained of water and an accident occur. If a valve has too much lift it is apt to stick, and should, therefore, be adjusted periodically as it wears. Feed-pipes should in all cases be of ample size, owing to their liability to fur up. Bends in the suction or delivery pipes should be avoided. Take every precaution to prevent sand or grit getting into the feed-water.

15. *In case of Low Water.*—In case of low water—that is, where none shows in the gauge-glass or lower test-cock—draw the fire immediately; but, should the furnace crown be red-hot, cover the fire with earth or wet ashes so as to smother it. Close the damper and ash-pit door and open the furnace door. If the boiler is very hot, and the heat is likely to be much intensified by drawing the fires, it would be well to smother them instead of drawing, but judgment should be used, as no fixed rule can be laid down. If a little water is shown by the

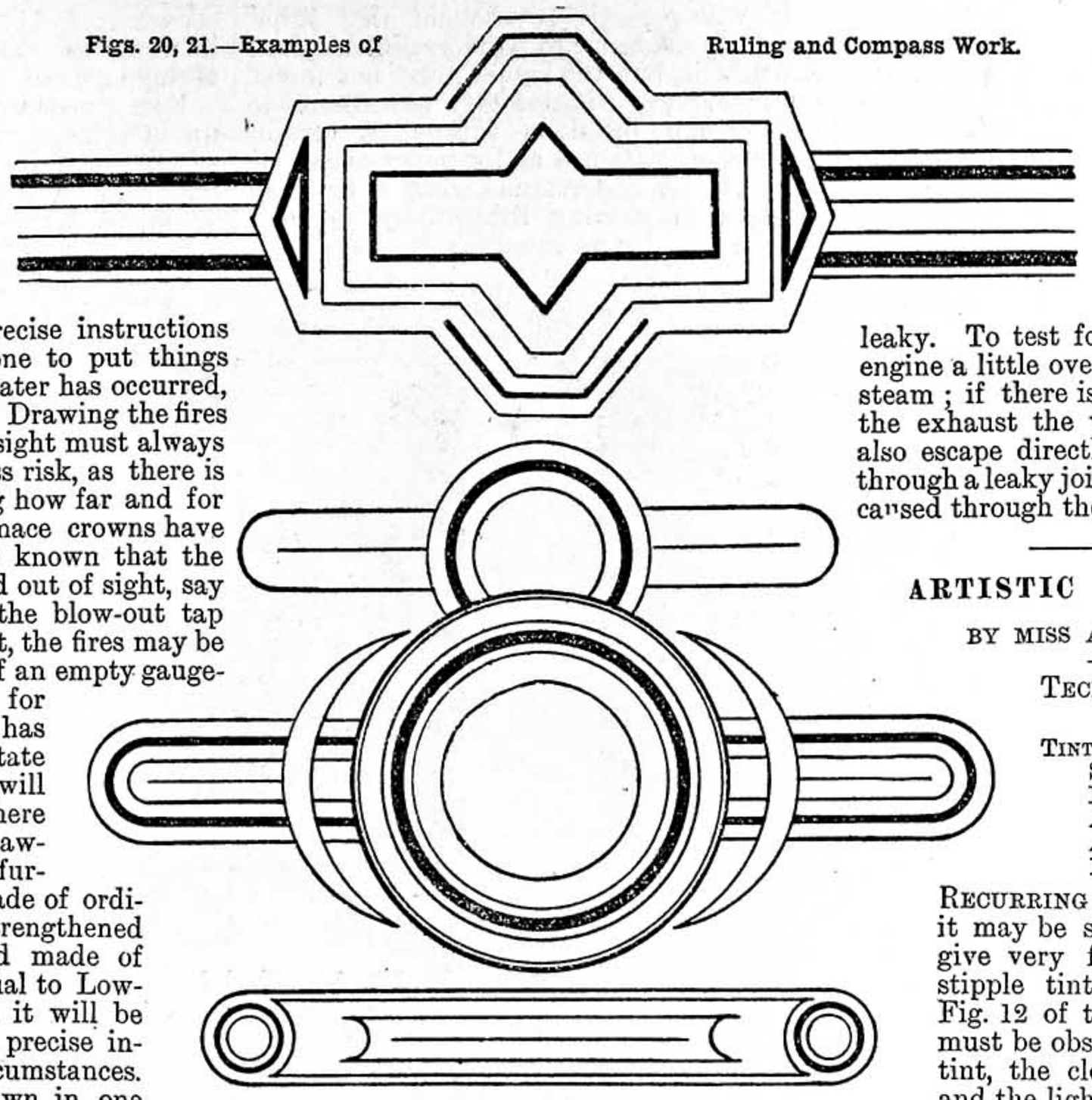
lower test-cock, the feed may be turned on.* The Manchester Steam Users' Association say in this connection: "Shortness of water generally arises from neglect of the boiler attendant, and ought not to occur. It is by no means easy to give precise instructions as to what should be done to put things right when shortness of water has occurred, so as to meet every case. Drawing the fires when the water is out of sight must always be a matter of more or less risk, as there is a difficulty in determining how far and for how long a time the furnace crowns have been laid bare. If it is known that the water has only just passed out of sight, say from the sticking fast of the blow-out tap when attempting to shut it, the fires may be drawn with safety. But if an empty gauge-glass has been mistaken for a full one, and the boiler has been worked on in this state for some time, the case will be different. Again, there would be more risk in drawing the fires from a plain furnace tube, or from one made of ordinary plates, than from one strengthened with encircling rings, and made of ductile steel or of iron equal to Lowmoor or Bowling. Thus, it will be seen, it is difficult to give precise instructions to suit all circumstances. A fire may be safely drawn in one case and not in another."

16. *In case of Safety-Valves Sticking.*—Should the safety-valve stick from any cause, and the pressure of steam be near the blowing-off point, (1) keep the engine running, and if steam is taken off for any purpose, open the valve; (2) start the feed-pump; (3) close the dampers; (4) open the furnace door; (5) if thought necessary, damp down or choke the fire with wet ashes.

17. *Priming.*—In case of priming, close the throttle-valve for a short time, find the true level of the water, and open the cylinder-cocks. If the water level is correct, blow off a little occasionally and add fresh water, but not too much at a time. Check the draught to the boiler also, and damp the fire somewhat. See that the feed-water is not dirty or greasy. In boilers where the steam space is small, great regularity of firing and water supply is necessary. If the priming is violent, stop the engine. Open the cylinder-cocks occasionally. Some of the compounds sold to remove incrustation will cause priming. Priming may also be caused by bad circulation, by an excess of steam being drawn from the boiler, or by the introduction of oatmeal or similar substances with the object of stopping leaks. In case of violent priming, the gauge-cocks will discharge a mixture of steam and water instead of plain water. It should not be attempted to stop priming by the introduction of oils, as is sometimes done, as most of these develop fatty acids, which are often highly injurious to the boiler, and by mixing with the lime or other incrustation prevent a proper contact of the water with the boiler-plates; there is therefore a much greater tendency to burn.

18. *Examine and Test Steam Exhaust.*—An experienced and careful attendant can gather no little information as to the working condition of his engine by attentively listening to the pulsation of the steam exhaust. If the piston, slide-valve, and passages are in good order, the sound of the exhaust will be regular and decisive. If the piston is out of order, or the rings broken or worn, the pulsation will be prolonged, accompanied by a rumbling, groaning noise. If the pulsation is prolonged, with a wheezing noise, probably something is wrong with the slide-valve, and it may require adjusting or re-bedding. In either of these cases steam is wasting past the piston or slide-valve, and should receive immediate attention. To test for a leaky piston, put engine on dead centre and listen to the exhaust; should there be an escape of steam the piston or rings require attention, or the cylinder may want re-boring. The piston should be tried at both ends of the cylinder. If there is a simultaneous discharge of steam through the pet-cocks at both ends of the cylinder, you may be sure the piston is leaky. To test for leaky slide-valve, place engine a little over half-stroke and turn on steam; if there is a rush of steam through the exhaust the valve leaks. Steam may also escape directly into the exhaust-pipe through a leaky joint. A leaky piston may be caused through the engine being out of line.

* See "Handbook for Steam Users." M. Powis Bale (Longmans & Co.).



Figs. 20, 21.—Examples of Ruling and Compass Work.

ARTISTIC LITHOGRAPHY.

BY MISS ADA J. ABRAHAM.

Technical Work — More about Stippling.

Tints in Lines and Stars—Tints Shaded up from Solid—Ball in Stipple Work—Examples of Ruling—Temperature of Stone—Finger-Marks.

Recurring to the subject of stippling, it may be said that Figs. 10 and 11 give very fair examples of shaded stipple tints, worked in stars, and Fig. 12 of tints worked in lines. It must be observed that the darker the tint, the closer and larger the dots, and the lighter the tint, the finer and more open the dots are, this being an infallible rule in stipple work. Fig. 13 is another example of shaded lines, which the student would do well to copy.

In a shaded tint where the darkest part is perfectly solid (Figs. 14 and 15) the student will find it impossible to shade it to a light tint without filling in; but the better the dots are laid in in the first instance, the less work is subsequently required. In an unimportant part of the picture it is not necessary to spend so much time in making a perfectly executed tint of regular dots, as long as the necessary effect of an even tint is produced. Fig. 15 is a specimen of what would be required for a good piece of shading, such as that on a face, an arm, etc., and Fig. 16 that for an unimportant part of the picture, such as a shadow thrown by a table. When the student is able to do a ball like that which is shown in Fig. 17, he may consider he has crossed the *pons asinorum* of stipple work.

Only two examples of line work are given (Figs. 18 and 19), as every different subject requires a different treatment; and here the student's artistic knowledge stands him in good stead, as he will then understand not to put the same kind of work in drawing a vase as if he were drawing a carpet.

The above examples of tinting are merely a few specimens of what is required in lithographic drawing with regard to stipple work, as each student can only gain by his

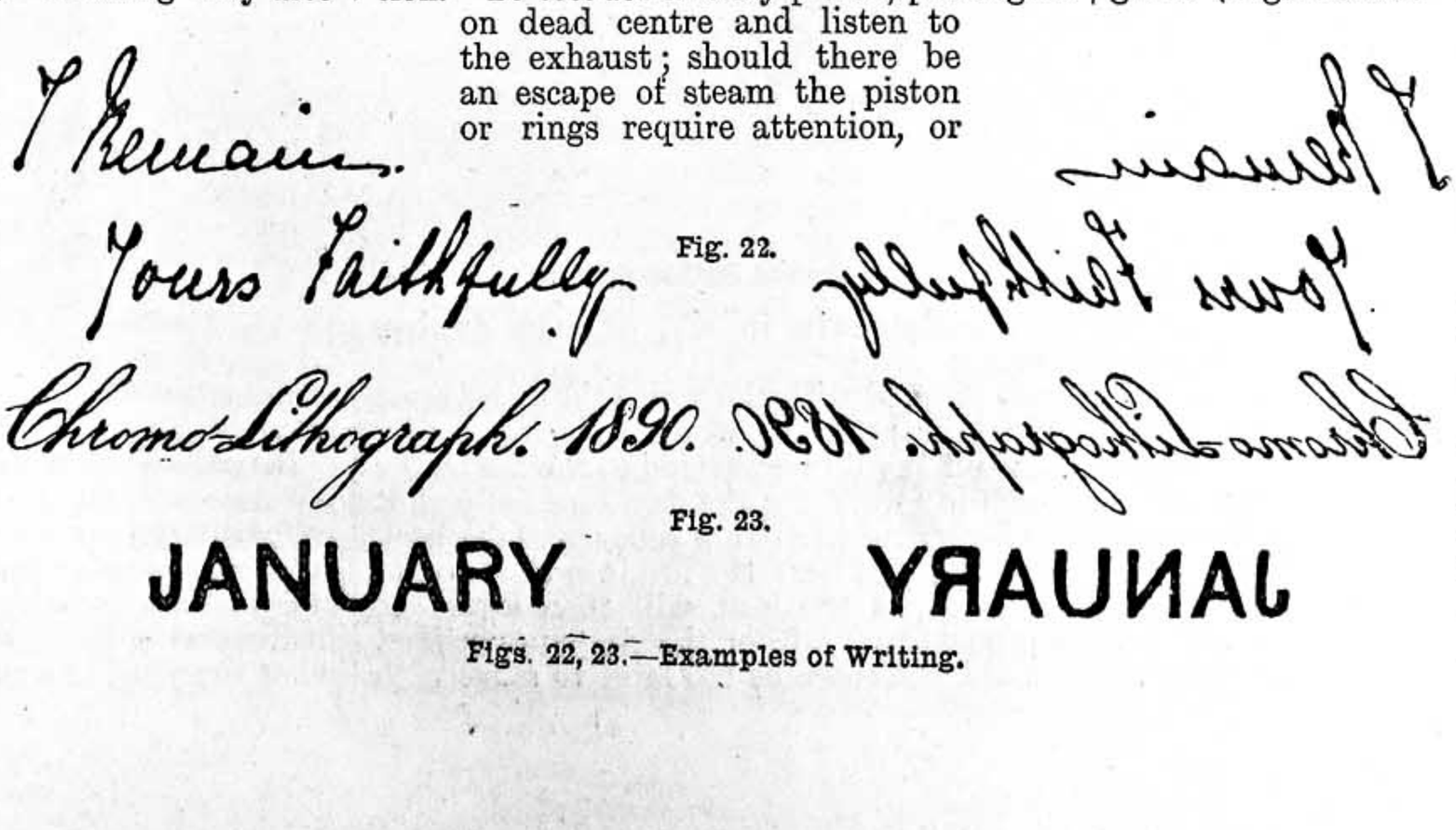


Fig. 22.

Fig. 23.

Figs. 22, 23.—Examples of Writing.

own experience the various styles and textures necessary for different kinds of work. It being found impossible to give many specimens of ruling, using the compass, lines drawn with the brush, writing, etc., Figs. 20, 21, 22, 23 must suffice at present as a slight guide to the student as to what will be required from him in that direction; but he must perfectly understand how necessary it is to practise with the different instruments before attempting any practical work. For instance, he will find the bow compass slip all over the stone, until he obtains full control in holding it firmly on one point, allowing the pen to glide easily over the stone; the same applies to the ruling pen, as it must be allowed to glide over, and not be pressed on the stone; and it will not be out of place here to observe, that it is easier to join straight lines to circles than *vice versâ*. The brush will be sure to make a thicker line than is required, until the student obtains a touch delicate enough only to work on the point.

It will perhaps be thought that lithography is made out to be more difficult than it really is, but the reader must not forget that good work is not easy to accomplish, and cannot be done without a certain amount of patience and perseverance, and if the artist understands what is required of him in starting lithography, he will not be as disappointed as if he thinks he can learn it in six, or even twelve, months.

To proceed with the work, the artist must remember never to work on a very cold stone; it should be warmed at the fire before beginning work for the day, especially if it has been kept in a damp cellar, and the back should be put next the fire in preference to the front, as the heat will then draw the dampness away from the drawing surface. Should the stone be too large to move with convenience, heat a flat piece of iron and hold it close over the stone for a short time, taking care not to touch it.

Finger-marks on the stone are apt to roll up in printing, and may appear as black smears—in fact, leaning against the stone might make it greasy, and so have the same effect as if it had been drawn in ink.

In practising tinting with the pen, it is not necessary for the student to confine himself entirely to one style of work in any one subject, such as an arm or hand, for example. It is, in fact, necessary, at times, to blend dots in lines with those in stars. For instance, when drawing an arm, in order to give force

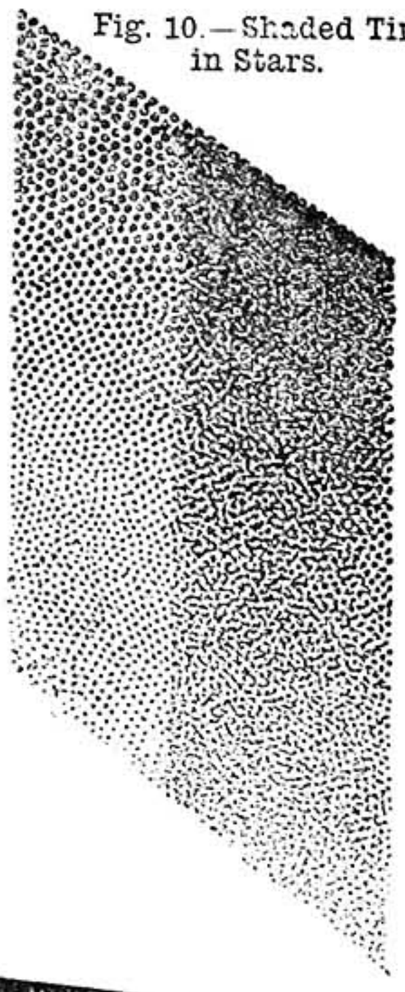


Fig. 10.—Shaded Tint in Stars.

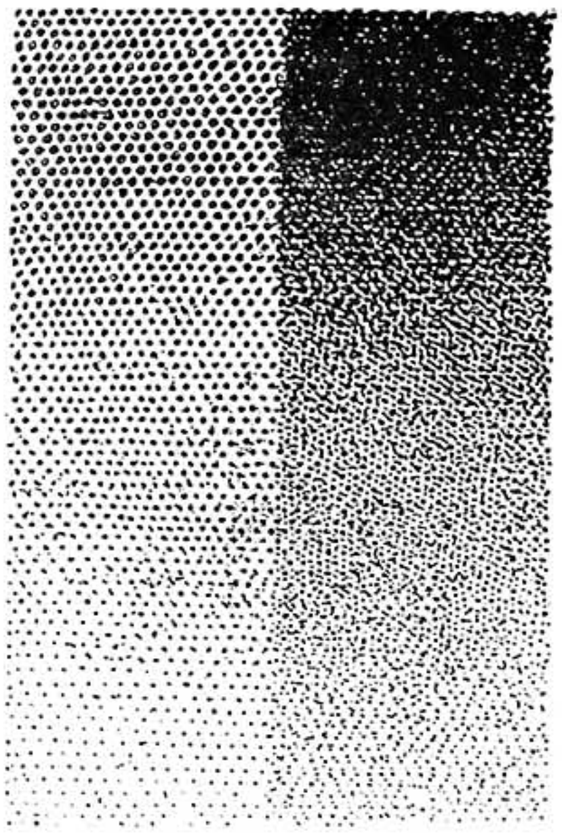


Fig. 11.—Shaded Tint in Stars.

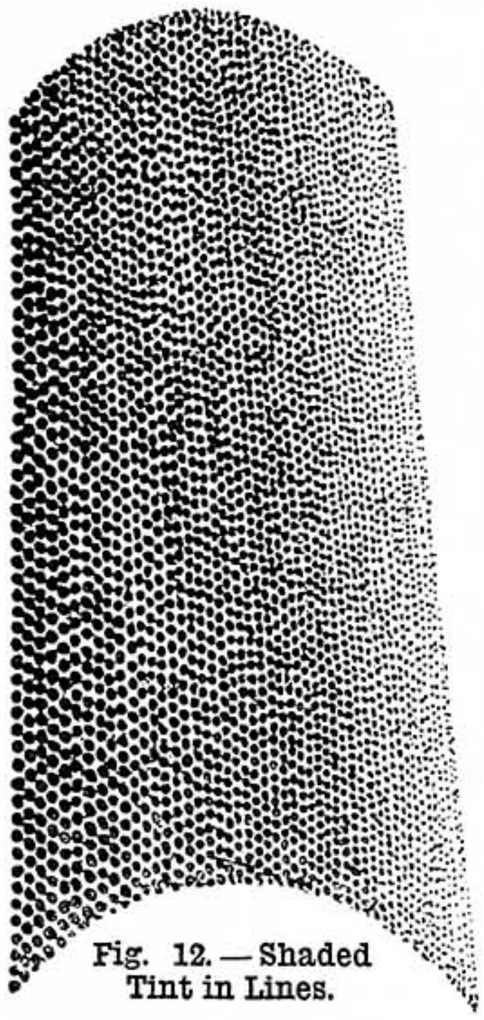


Fig. 12.—Shaded Tint in Lines.

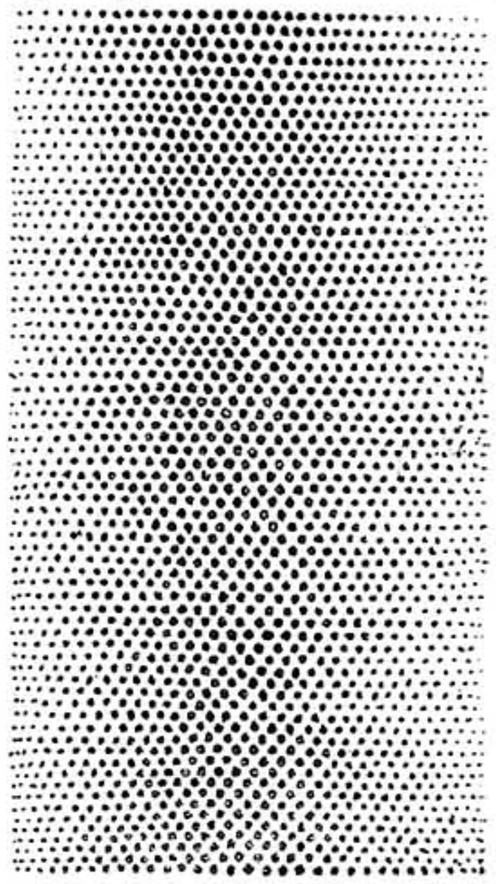


Fig. 13.—Shaded Tint in Lines.

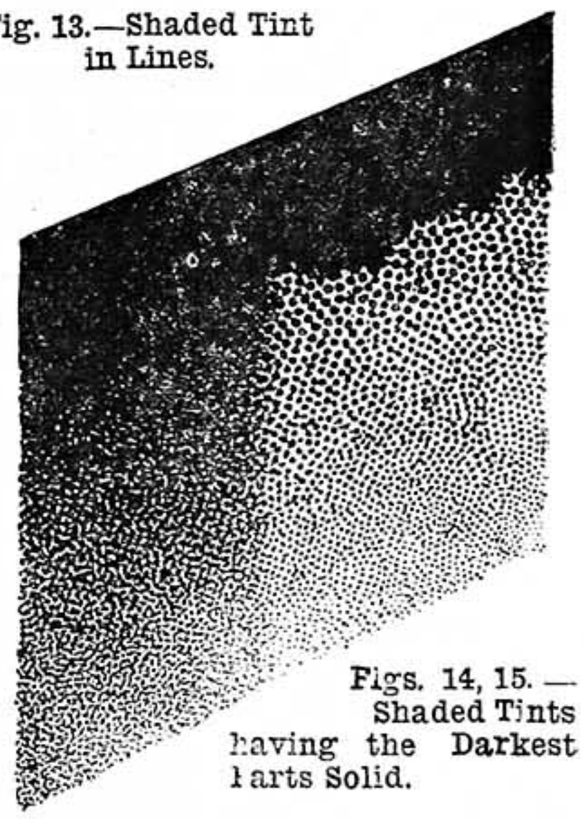


Fig. 14.

Figs. 14, 15.—Shaded Tints having the Darkest Parts Solid.

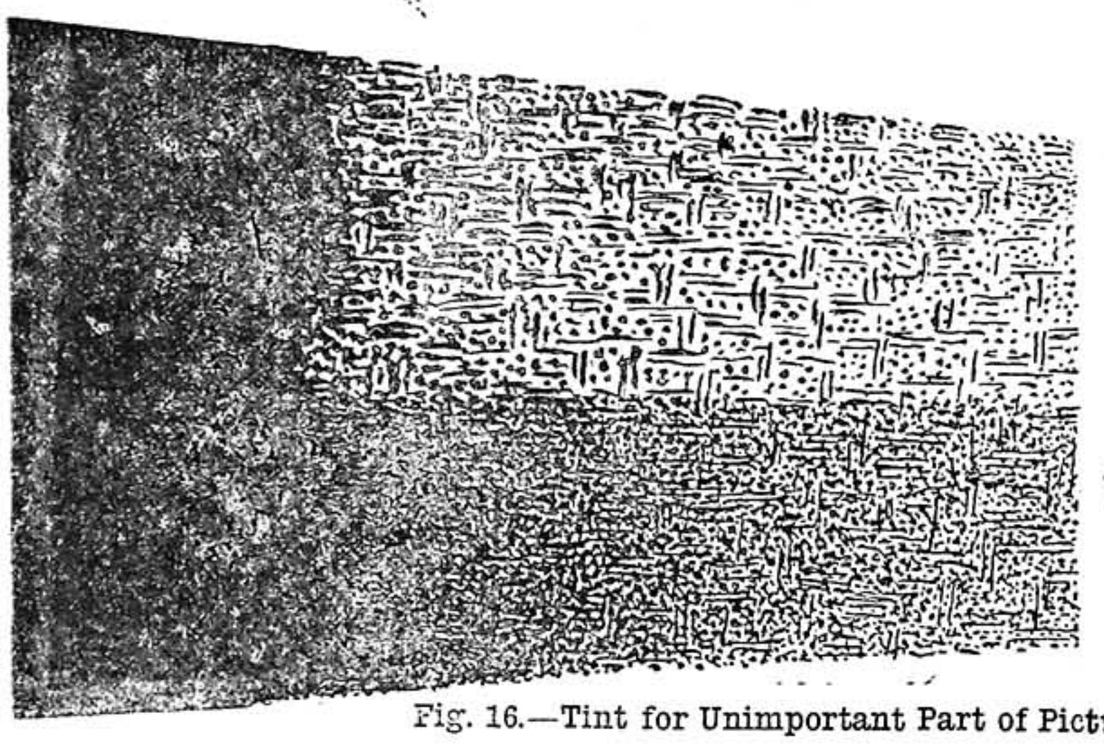


Fig. 16.—Tint for Unimportant Part of Picture.

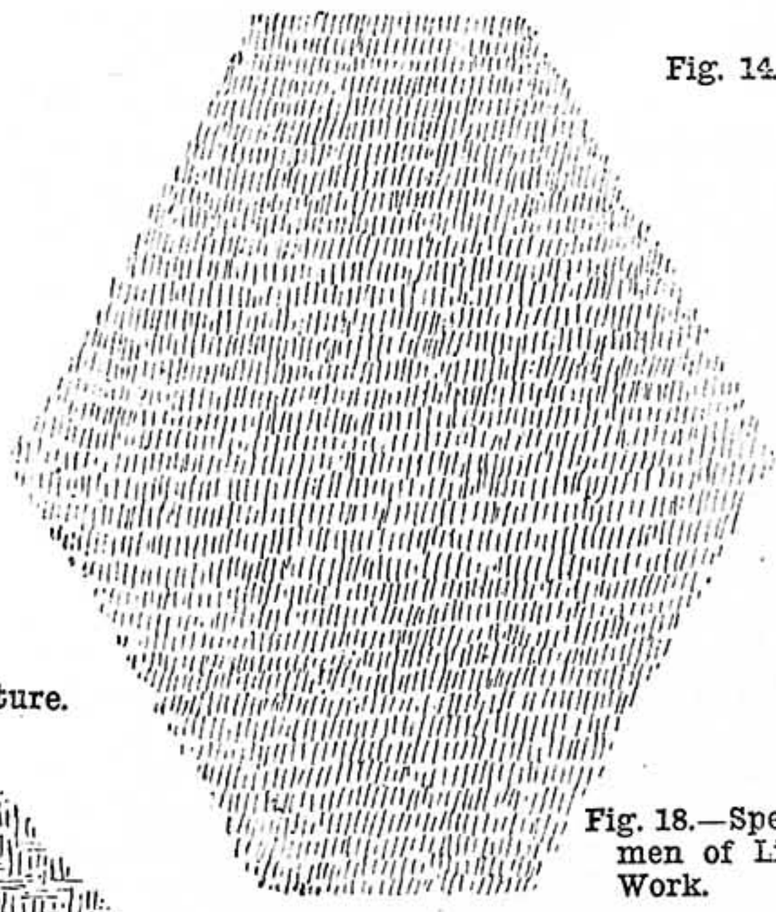


Fig. 18.—Specimen of Line Work.

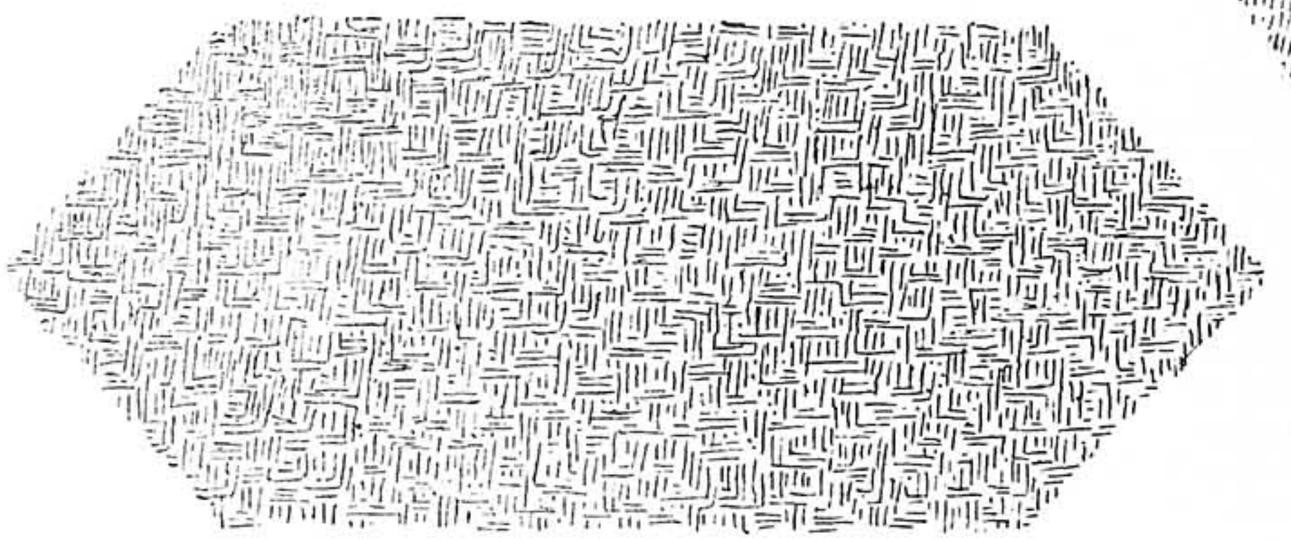


Fig. 19.—Specimen of Line Work.

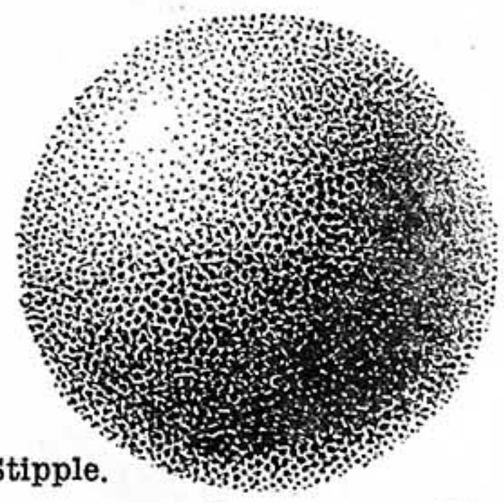


Fig. 17.—Shaded Ball in Stipple.

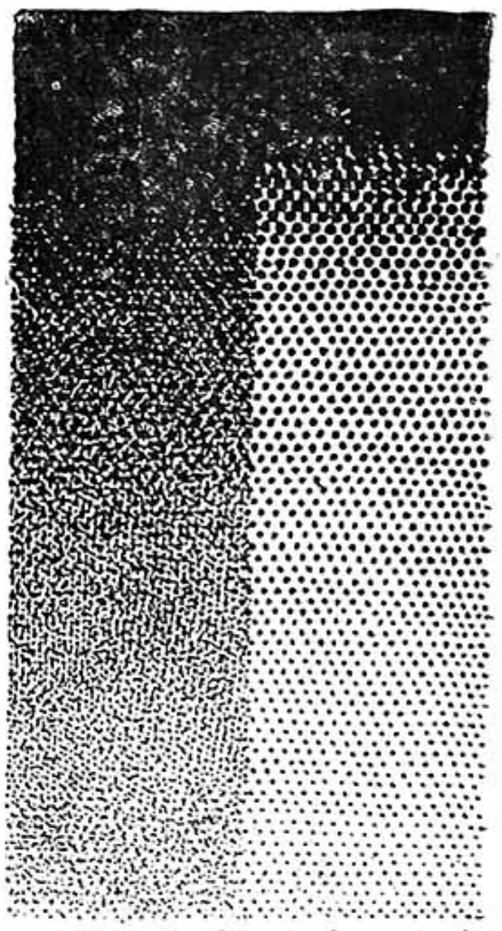


Fig. 15.

to the drawing, as there is no decided outline, about three or four rows of dots in lines should be drawn down the edge, the last row being finer than the others to give softness and roundness to the figure; this would be gradually worked off into stars towards the high lights, thus giving effective drawing and shading in the one tint by the judicious management of the dots. In the same way in drawing a face, parts, such as those under the eyebrows, round the wing of the nose, the mouth and around it, near the ear, etc., would all be drawn with the dots in lines, in the various directions of the features; whereas the forehead, cheeks, neck, etc., would be drawn in stars, thus giving a certain amount of modelling, and helping the shading by giving much more character to the subject than if a flat tint were laid equally all over the drawing and then filled in, for however well it may be modelled, the drawing would always have a flat appearance—insipid, if I may use that expression, and without character.

In filling in a tint, the student should not look as closely at his work as when he lays in the dots in the first instance, for if he does so, and then regards it from a distance of about a couple of feet, he will, no doubt, be very surprised to see what a patchy appearance his drawing has. This is owing to the fact that in looking so closely at his work he fails to take in the general effect; so if he looks closely at his work, and is careful in laying in the dots clearly and evenly, and then fills it in from a little distance, he cannot fail to get a clear drawing and evenness of texture. It is not a bad plan to sit down to lay in the dots and stand up to finish it.

With regard to the student's position whilst at work, it is better for him to sit facing the light for all such work as writings, maps, etc.—in fact, that class of work which appertains to the draughtsman; but for artistic drawings and colour work, nothing equals a side or, if possible, a top light. Let the novice take any ordinary water-colour sketch, and, facing the light, look down upon it, and afterwards place it so that he looks at it from a side light, he cannot fail to see the difference that I mean. Naturally, this would apply the same to copying from it on stone, for it would be a great mistake to sit facing the light to work on the stone, and, having the copy on the right or left, be continually turning round to look at it. It is surprising what a different effect the drawing has when held at a different angle to the stone on which one is working. Certainly, the best way is to have the drawing in front of you; but should this be impracticable through want of space, etc., the artist should, at any rate, endeavour to so arrange his copy that he looks at it as nearly as possible full face—*i.e.*, at right angles, and not sideways. Some people cannot face the daylight when at work, and many maintain that it is actually injurious to the eyes to sit with the face to the light day after day, such as regular office work entails. Here is a case of "what is one man's meat," etc. On the whole, the best advice I can give is this—secure the best available light for your work with the least possible injury to the eyes.

A HANGING MEDICINE CUPBOARD.

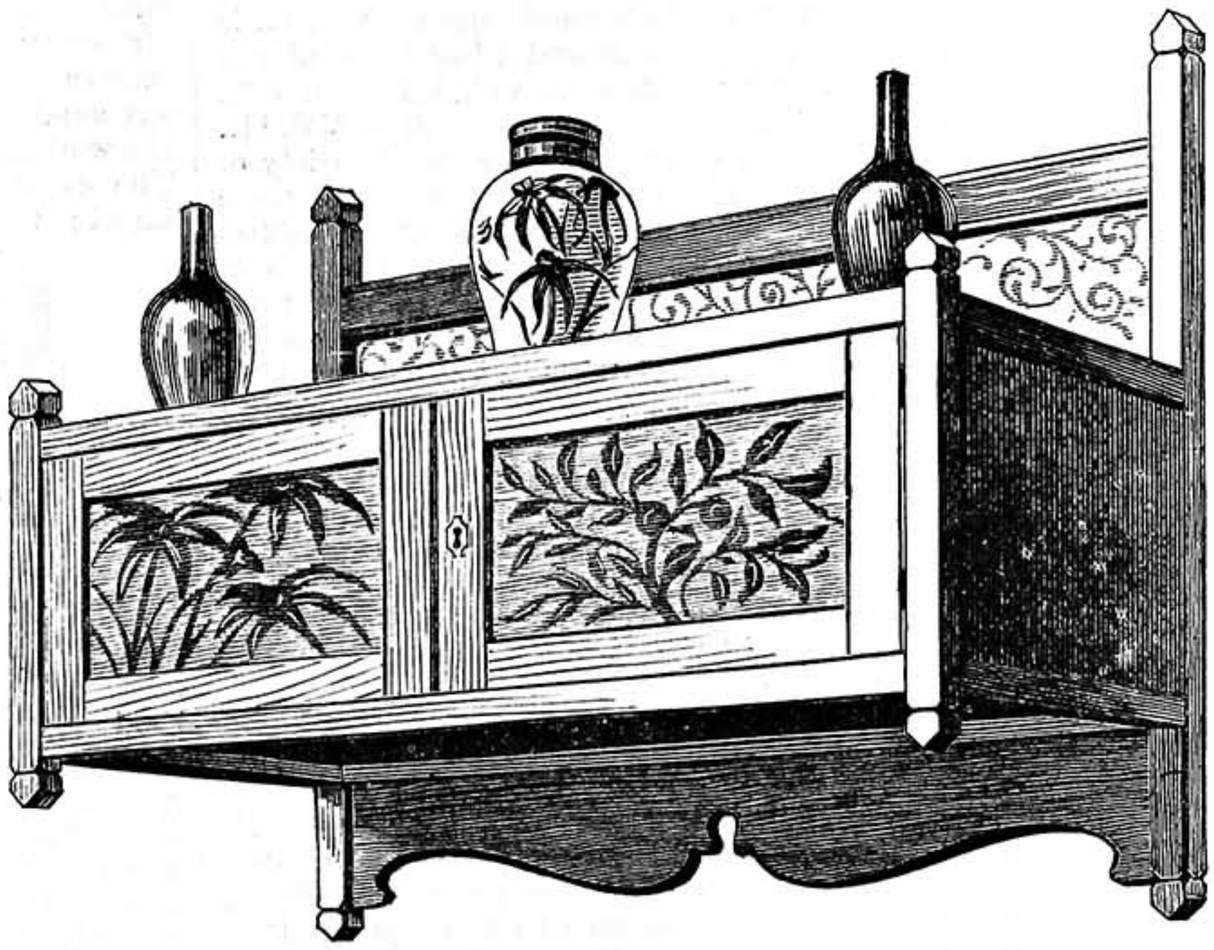
BY B. R. CONDER.

ALTERNATIVE USE FOR CUPBOARD—DIMENSIONS—CONSTRUCTION OF FRAMEWORK — DOORS — DECORATION OF PANELS—FINISHING—COST OF MATERIAL.

SMALL cupboards are so generally used in the present day in rooms of all kinds, and are so generally useful, that many may like to know how they may be easily made.

The small article here described, though primarily intended for a medicine cupboard, can be easily adapted to answer a different purpose. By substituting glass for wooden panels to the doors, and lining the interior with some suitable decorative material, such as lincrusta, Japanese paper, or plush, it might be converted into a handy receptacle for a few small curios and knick-knacks.

Its dimensions are as follows:—Width, 2 ft.; depth, 8 in.; height of cupboard proper, 10 in.; extreme height in front (*i.e.*, of uprights), 12½ in.; at back, 22 in. This is a handy size; but it can, of course, be altered to meet individual requirements.



A Hanging Medicine Cupboard.

The framework of the cupboard, which must first be prepared, consists of twelve strips of wood ⅞ in. square, four being upright and eight horizontal. They are mortised and tenoned together; the tenons, of course, being cut in the horizontal rails, and the mortises in the uprights. It will be obvious that these joints must be carried only about ½ in. through the uprights, and that, therefore, the horizontal rails must be about ¾ in. shorter than the extreme width and depth of the cupboard respectively; also that the joints must be cut as near the outer edges of rails and uprights as practicable. It will be necessary at this stage, and from time to time as the various parts are got ready, to fit the work together, and test it with the square.

Next prepare the cross-ties, shown in the drawing, one above, the other below, the cupboard at the back. They are to be let into the back uprights from behind, the joint used being the lap-dovetail, the construction of which has been clearly explained in WORK, Vol. II., page 118.

The upper tie is 1½ in. wide and ⅞ in. thick, which is also the thickness of the uprights to which it has to be joined; these joints must therefore be halved. The height of this piece above the cupboard is sufficiently indicated by the drawing, and is not material; a plain beading is cut on its front edges. A very passable beading may be easily contrived with a little care and patience, by those who do not possess beading planes or router, with a cutting gauge, chisel, and glass-paper. The cross-tie below the cupboard is ½ in. thick, or less, and 3 in. wide in its widest part; its lower edge may be cut to some such shape as shown with a frame saw, or failing that, with a keyhole saw. The panels forming the sides of the cupboard may now be got ready. They are ¼ in. thick, and fit in grooves cut in the side rails and uprights. The top and bottom next claim attention; they need not be more than ¼ in. thick, unless destined to carry more weight than usually falls to the lot of such a small cupboard.

The top, which forms a handy shelf for the display of a few small ornaments, is lap-dovetailed into the upper edges of the top side rails. The bottom rests in rebates cut on the lower front and back rails, and is secured to them by a few small screws or brads when finally fitted.

The ends of the uprights may now be cut as shown, or otherwise finished off, the various parts finally fitted together and glued up, and a thin back affixed. The back extends from the lower rail to the upper cross-tie, and thus the upper part of it forms a narrow panel above the cupboard. A small beading is fitted round the inside edges of the front, and allowance must be made for this in setting out the doors. The styles and rails of the doors are ⅝ in. thick and 1¼ in. wide, with the exception of the falling styles, which overlap, and are therefore ⅜ in. wider. A rebate of that width is cut on the inner surface of the right-hand and the outer surface of the left-hand style, to allow for their overlapping and shutting level. A small beading is cut on the lock style.

The door frames are mortised together in orthodox manner, but might be halved and screwed from the inside by any preferring that method. They must be either grooved or rebated for the panels, which are ¼ in. thick.

In small doors of this kind, rebating the styles and rails and securing the panels by beadings, or simply by brads, is, perhaps, the better plan, as it permits of the easy removal of the panels at any subsequent time without injury to the framing. The appearance of the cupboard will be much improved if the panels are suitably decorated.

One very simple and effective method of doing this is to cover them with Japanese gold leather paper. This is an expensive material if bought in the ordinary way—by the piece; but one of Liberty's 1s. 6d. remnant bundles will afford sufficient for decorating several small pieces of furniture. This wrinkle I got from an early number of WORK, and take this opportunity of acknowledging my indebtedness to the writer of the article in which it appeared.

A stop will be necessary to prevent the doors opening inwards, also some kind of a bolt to keep the left-hand door closed. A

very small block of wood glued or screwed to the front of the bottom, where the doors meet, acts as a stop; and a very efficient substitute for a bolt is provided by fastening a small wooden button, with a screw upon which it can be turned readily, but not loosely, to the inner surface of the falling style or top rail of the left door, about ½ in. from the top. When the door is closed this button is turned, so that the part of it then uppermost comes behind the top front rail of the cupboard, and the door cannot then be opened until it is turned down.

All now left to be done is to cut the key-hole, fix the lock, and hang the doors, and the cupboard is complete. I have said nothing about the wood to be used, as almost any kind would do, provided it be sound and dry. As a hint to those who desire to produce their work as cheaply as possible, without sacrificing good effect, I may add, that a cupboard I made for myself of good sound deal and enamel painted looks very well, and cost for material, including a good lock, less than 2s. 6d.

MEANS, MODES, AND METHODS.

How to tie a Painting Brush.

Many people who need a paint-brush, buy one, and find that it is too long and limp to work well. It needs tying. This is a difficulty to the inexperienced, and here is a "method" of tying a brush.

Fig. 1.—Commencement of Process. Fig. 2.—The Knot used to secure String. Fig. 3.—Mode of laying Cord on starting to bind. Fig. 4.—Completion.

First tie a piece of stout twine (twine like that used for Macramé work will do well) round the brush, leaving 6 in. or 7 in. at one end, marked A in the sketch. Fig. 1 shows the first tie. Fig. 2 shows the form of knot used. The end A should be made to lie along the hair of the brush, and the string should be coiled round it and the hair of the brush as many times as necessary. When enough has been wound around, the cord marked B may be bent back, drawn close, and a half knot made opposite the first knot. Both cords may now be fixed with small tacks to the stock or the handle of the brush, and the superfluous string cut off. The string need not be bound very tightly, for either paint or water will make it sufficiently tight for the purpose for which it is intended. At any time part of the string can be removed. B. A. B.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of* WORK *for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of* WORK *without charge, the notices given partake in no way of the nature of advertisements.*

37.—Practical Blacksmithing.

Some little time ago it fell to my lot to notice Vol. III. of a capital *vade mecum*, entitled, "Practical Blacksmithing," by Mr. M. T. Richardson, comprised in four volumes, and covering nearly the whole range of blacksmithing, from the most ordinary operation to some of the most complex forgings. It is an American publication, but is sold in London by Messrs. Kegan Paul, Trench, Trübner & Co., Limited, Paternoster Square, London, E.C., who will, I am sure, readily give any applicant information as to the price at which they supply it. Vol. I. gives the early history of the trade, with shop plans and methods of constructing chimneys and forges. Vol. II. is devoted to a description and illustration of the tools and appliances in use. Vol. III. dealt with such tools as had not been considered in Vol. II., and contained a description of a great variety of jobs of work. In Vol. IV. the last-named topic has been continued and completed, and considerable space has been devoted to the subjects of cutting, bending, welding, and setting tires, setting axles, resetting old springs, the tempering of tools, bolts, nuts, etc., and the working and welding of steel. The last chapter comprises a set of tables, giving the weights and sizes of various articles in steel and iron, used for the most part by carriage and waggon builders, and therefore of importance to all who are engaged in this particular trade.

38.—Photographine.

Some readers may like to try the compound known as "Photographine," which is prepared and supplied by Mr. J. Pawsey, 8, Catherine Terrace, Seven Sisters Road, Tottenham, N. He claims that by its use plates may be cleared without injury to the film years after being fixed, and that, by reason of its cheapness, it is economical in its use. Further, he claims that it hardens the film as well as clears the negative, and that this is a most desirable feature in the production of good pictures. Plates, too, that are over-developed speedily assume their proper density on being brought, it is said, in contact with this bath. The following developer is suggested for use:—For the soda solution, 3½ oz. of soda, 1 oz. of glycerine, and 1 quart of boiling water. For the pyro solution, 1 oz. of pyrogallic acid, 20 drops of nitric acid, and 8 oz. of water. For use, take 1 oz. of water, to which has been added 24 drops of the pyro solution; then add 1 oz. of the soda solution. After developing, well wash the negative in clean water, and then place it in the Photographine bath compound thus: 1 oz. of photographine, 4 oz. of boiling water, and ½ oz. of loaf sugar. This bath should be mixed twelve hours before being used. This solution will keep any length of time, but should be renewed as soon as it has lost its original colour—by turning black. *Caution.*—"Negatives treated thus print quicker and sharper than those treated in the ordinary way." The preparation is sold in 1 oz. packets, 4½d. post free, or in 1 lb. boxes at 6s., and 5 lb. boxes at £1 8s., carriage paid. The photographer whom I asked to test the Photographine sent as sample, says that it will clear a negative very much like many other agents, but that he fails to see its superiority or any advantage in its use.

39.—The Airedale Camera in Parts.

Messrs. Watkinson & Co., Harrison Street, New Briggate, Leeds, manufacturers of photographic cameras and scientific and laboratory apparatus, have sent for inspection an Airedale Camera in parts with finished brasswork, with a copy of their latest price list. Although mention has just been made of the Airedale Camera in parts, it must not be supposed that the camera itself is not supplied complete, and that it must of necessity be purchased. It may also be bought made up and finished, and some idea of its construction may be gathered from the accompanying illustration. The makers explain that the camera "has been designed to meet the requirements of those who want a really well-made practical and useful article at the lowest possible cost. Although very light, weighing only 2¾ lbs., it is very rigid. The bellows, being attached to the front, prevent any cutting of the picture." It is a double extension camera, and is fitted with rack and pinion. It also has a good leather bellows; a leather handle, by which it may be carried; and a reversing and swing back. It is made in half-plate and whole-plate sizes only. The price of the former, with one double slide, is £2 17s. 6d., extra slides being supplied at 9s. each. The price of the whole-plate camera is £3 7s. 6d., the cost of extra slides for this size being 14s. For the price it seems to be well made and well finished, and likely to prove a useful article to those who buy and use it. The same camera in parts—a decidedly new departure for amateurs—is just sufficiently advanced in its construction, and in such a state of finish, that any amateur who is fairly well acquainted with the working of a camera could easily complete it. The *woodwork* consists of the body, ready dovetailed; the baseboard, clamped and ploughed

Watkinson & Co.'s Airedale Camera.

ready for rack and pinion; bellows frame, reversing frame, ground glass frame, and extension frame, all mitred, keyed, and glued; slide rails; front with circular cut ready for lens; double grooving for one slide and two shutters, clamped and rabbeted. The *brasswork* necessary for completing the camera includes rack and pinion, side struts, milled screws, double hinges, ground glass clips, reversing clips, box-board hinges, front bar, hook, turn-buttons, extension rods, and guide strips. In addition to this there are other necessary parts, which are neither woodwork nor brasswork, but which may be described as "sundries." These are the leather bellows, handle and bridges, ground glass, zinc partition with spring, side clips, and hinges; and in addition to these the screws necessary for the completion and putting together of the camera and one slide. The camera in parts is supplied in three different stages, as follows:—(1) The woodwork, as mentioned in detail above, with flat brasswork unfinished, but with all turned work finished, at 35s. (2) With all the brasswork highly finished and lacquered, 40s. (3) With brasswork finished and lacquered, and one double slide finished completely and ready for use, but not polished, 45s. If a polished slide is desired, an extra charge of 9d. is made. The Airedale Camera in this form seems likely to meet the wants of many amateurs who would like to be able to say that they had made their own camera, but who are not possessed of sufficient skill in joinery and cabinet-making to do all the clamping, ploughing, grooving, and rabbeting that is required in the woodwork. To carry out these operations, the amateur woodworker must not only have acquired considerable proficiency in his adopted art, but must have by him many special tools which amateurs do not usually have in stock. It is a difficult matter beyond doubt to prepare all the parts, but to put the parts together is comparatively easy.

The Editor.

SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Carriage Varnishing.—H. B. (*Brighton*) writes:—"In his well-written and practical instructions to Barouche on the above subject (see page 123, No. 112, Vol. III.), and at the sixth line from the bottom of column indicated, J. C. K., in writing re the taking off of hind seat of Stanhope phæton, advises that if the screws, by which it is fixed to body, cannot be drawn by turn-screw (*i.e.*, screw-driver), and are set fast by rust, the heads of such screws need to be chipped off, etc. Permit me to point out that this method should only be resorted to as the very last in a severe extremity. Reason—because it is twenty chances to one that in so doing the seat end is almost sure to be either split or severely damaged, sometimes even requiring the ends or bars to be entirely renewed. Having had all kinds of 'jobbing,' and many years' practice in all the endless ramifications of that branch, I have had to wrestle with hundreds of such screws, and have very seldom failed in withdrawing them, and rarely with any damage to the parts effected. I proceed as follows: Finding by the turn-screw that the screws will not move, in the case of the seat named, I should procure a piece of round iron rod of such a size that, when placed end on, the rod is a trifle smaller than the head of screw. The rod may be 18 in. long, or sufficient to give good 'cold' hand hold at one end when the other end has been heated. Then have one end heated to a very bright red, and hold it, end on, to head of fast screw, and in a minute or two that screw can be easily withdrawn with the turn-screw. For a number of such I should have two rods to save time—one getting hot while using the other. The wood immediately round the screw may get just a little singed, but that is of no consequence, as compared with a split seat end; besides, the saving of time is also a most important item. And while writing of hot irons, I may mention that where screws become rusted in the plates, etc., of under carriage work, they can be loosened same way by holding hot tire bars over three or four at a heat, and again save much valuable time. By these means I have drawn screws which nothing else could be made to move, and I have neither broken a blood-vessel, raised a blister, or turned a hair. Another most useful application of the hot iron can be effected where, through accident or carelessness, bruises may have been made in new, and even in some places in old, bodies. Thus, suppose a new panel on one of the sharp corner mouldings has received a blow, causing a very unsightly indentation, proceed in this wise: If bare wood, well soak the part affected with clean cold water for an hour or two, according to extent of damage; then get a piece of tire bar wider than the bruise, heat to a dull red, and hold near enough so as not to scorch the wood, and as the iron gets cooler approach it nearer. When cool enough not to burn, lay it right on the bruise, and it will, if properly and carefully done, draw the bruised place out level with its surroundings, when, if glass-papered off, it will never show; but if left in its damaged state and 'stopped' up in the painting, the 'stopper' is always liable to fall out and spoil the whole job. I trust J. C. K. will not feel offended at my intrusion upon his ground. Should you, Mr. Editor, think it likely, please do not print this in 'ours,' if indeed you consider it worth inserting at all. I am an old Polytechnic student, and had the good fortune to sit for four or more sessions under that prince of technical teachers, Mr. John Robertson, and I feel an old boy's interest in all these matters; and having a great desire to see coach-building in all branches more fully developed in Work, shall always do all I can to further it."

Rate of Circular Saws.—Erratum.—A. R. (*Scorrier*) writes that the letter headed "A Woodworker" (see page 187, Vol. III.) emanates from him, and is in reply to A Woodworker's letter on page 91, Vol. III.

Petroleum Engines.—C. J. C. (*No Address*) writes:—"If J. H. D., in Work of May 2nd, 1891, refers to the 'Priestman' petroleum engine, in the second part of his explanation of oil-engines, I must respectfully correct him on one point, viz., that the impulses occur at such comparatively long intervals that they require much heavier fly-wheels, in proportion to their power, than steam-engines. No doubt the oil-engines require heavy fly-wheels, and so do gas-engines, but the 'Priestman' oil-engine gets an impulse, certain, every fourth stroke of the piston, or every alternate revolution of the fly-wheel. On account of its steady running, it is admitted to be one of the very best motors for electric lighting, which would hardly be the case if the impulses occurred at long intervals. J. H. D. appears to be correct in his explanation of the mixing of air, vaporising, etc., but the bichromate battery is not of such magnitude as he implies. If I am mistaken, and J. H. D. did not refer to the 'Priestman,' I should esteem it a favour if he would inform me, through this paper, what oil-engine he referred to, as I am not aware of any other reliable except the 'Priestman.'"

II.—Questions Answered by Editor and Staff.

Saw Hammering.—New Zealand asks for some plain directions as to saw hammering. The following information will be practical and theoretical. I give two or three very rough sketches, so that New Zealand may clearly understand me. Fig. 1 represents a saw-plate tight at the centre; when placing the straight-edge on the plate it shows it to be convex, and if you try to push the centre down it will spring back again; to get the plate flat or true, the tight place should be struck on both sides of the plate with the dog-head hammer. Fig. 2 represents a saw tight at and near the rim but loose at the centre; in this case the hammering should be done near the rim, or where it is tight, and with the dog-head hammer. It will be seen that this plate shows itself concave; if the plate is reversed

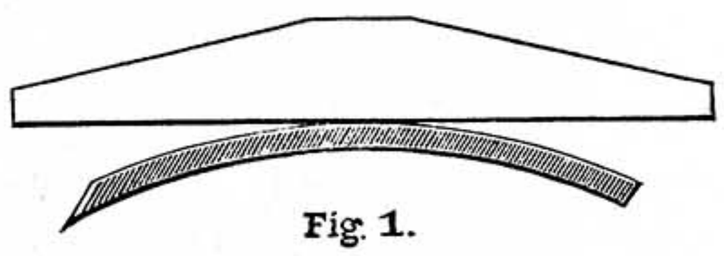


Fig. 1.

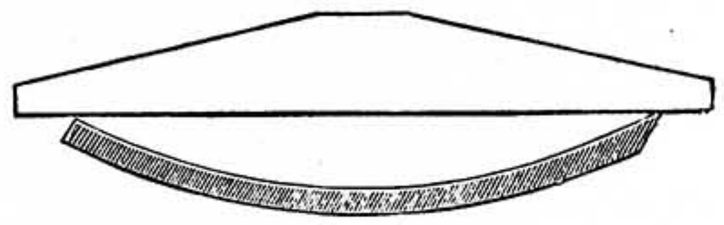


Fig. 2.

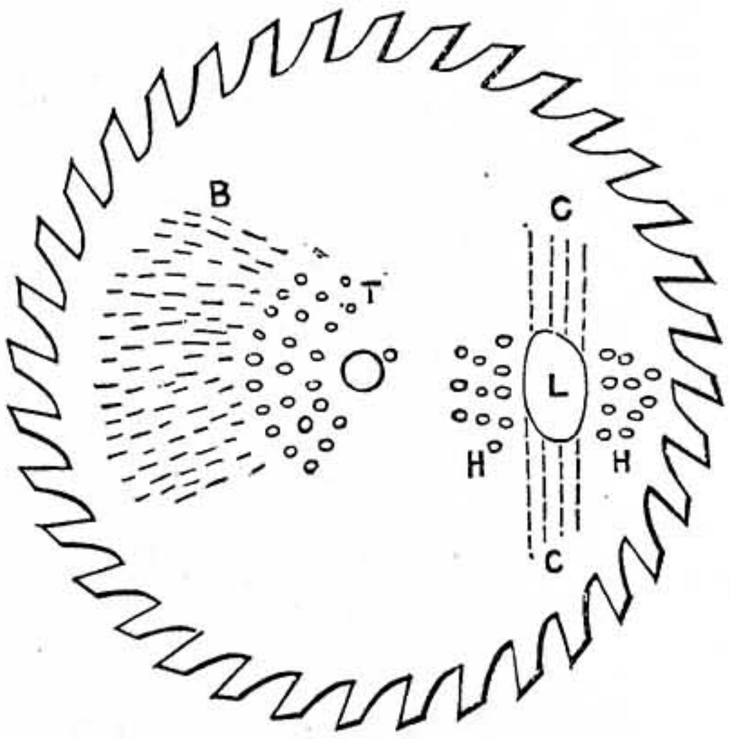


Fig. 3

Saw-Hammering Marks and Bends.

and the straight-edge placed on it, the centre drops with the least touch precisely the same as before, showing that the centre is loose. Fig. 3 represents a circular saw loose or slack at L. To take this out, the plate should be struck with the cross-faced hammer, as at C C, and with the dog-head, as at H H, or it may be struck all round with the dog-head hammer. By your statement of your 12 in. saw it must have been stretched on the outside, or rather at the rim, and pinched or twisted. I have often seen saws in this condition, but have never got them perfectly true, but if put into the hands of a man who has learned the whole art of hammering they may be made perfectly true. The way I proceed with a saw in like condition is to hammer all round the plate on both sides with the dog-head hammer, as at T, in Fig. 3, then with the cross-faced hammer all round the plate, as at B, and I have in most cases got the plate true enough to do good work.—A. R.

Bicycle Wheels.—H. B. (*Ewell*).—Get a shilling bottle of cement for mending cuts and splicing tyres at any cycle warehouse. Make the spliced surfaces very clean, or cut them anew with a sharp knife dipped in water. Get a bottle of Snell & Brown's Octopus cement. Smear both the splicing surfaces, and let stand for two or three hours before sticking together; then place the splices evenly and press together, and it will at once be ready for use on the wheel. With Lucas's cement you smear the splices and stick together at once, but the tire should stand for an hour or two before putting it on the wheel or using.—A. S. P.

Bicycle Plating.—F. S. (*Bristol*).—There is no stuff that can be put on to serve for plating. Send the parts to be plated to a regular nickel-plater's. You do not require to do anything with them in the way of preparation, except perhaps removing paint. They will prepare the articles for the bath themselves.—A. S. P.

Painting on Silk, etc.—Silk Banner.—Before painting or gilding, so much of the space as is to be covered, *and slightly beyond its outline*, must be sized. This is to stop absorption, and to prevent the oil from running. A preparation for the purpose is sold at artists' colour shops, or may be made by dissolving isinglass in water or by boiling down cuttings of parchment. For gilding or silvering, oil gold size can be used on this ground; and for painting, ordinary tube oil colours. To prevent cracking, care must be taken not to lay on the colour too thickly, but to thin it down well with turps. It is better to attain the desired depth of colour by two thin coats than by one thick one. As regards varnish: if the colours are found to dry equally dead throughout, varnishing becomes simply a question of taste. Some prefer the dead painting, which shows equally in all lights. But should the colours dry dead in some parts and bright in others, varnishing becomes necessary to glaze them all alike. Some mix a little varnish with their colours, and thus get a sufficient glaze throughout.—S. W.

Incubator.—H. H. Lindon (*Higher Bebington*).—You are, unfortunately, not the only one who has found the same difficulty with the machine described in No. 89, Vol. II. You certainly will not get 104° in the egg drawer with the tank heat only 116°. The remedy therefore is: use more heat—a larger burner—although I must say a burner taking a 2½ in. wick ought, in my opinion, to be sufficient. Roughly speaking, tank heat should be almost double that required in the egg drawer. Turning to the article in question, I find a case measuring 16 in. by 16 in. outside is recommended, made of ¾ in. stuff, and a boiler 15 in. by 15 in. How the latter can be fitted into the case, besides leaving room for packing, is a poser. In my own experience with a 16-egg hot-water machine, I found 2 in. of sawdust packing round and above boiler, and round egg drawer also, to be about right, and could, with a burner taking a ¾ in. flat wick, get 120° in egg drawer. Judging from this, it seems to me that your machine needs padding to keep the heat in, in which case it would hold only about sixteen to twenty eggs, instead of thirty. This meaning a lot of trouble, I would advise you to put your machine away for the present, and await the appearance of my article on a Hot Air Incubator, to which you may be able to adapt your present case without much alteration, and which, I am sure, will give you satisfaction.—Leghorn.

Incubator.—Incubator.—Why a zinc tank should become eaten through and leak after twelve days' use is a mystery I should like solved. What zinc did you use—new or old? What did you use as a flux for soldering? and did you take care to wash off all the surplus fluid? If killed or unkilled spirits (so called) were used, and the joints left unwashed after soldering, it would account for a little, or perhaps all, of the trouble. If you took this precaution, the only solution of the matter lies in the fact that some powerful corrosive must have, by some means, been introduced into the tank. Pure rain water certainly cannot be answerable for it, so I can only conclude that it became contaminated before use. For the future, use ordinary fresh water. The small amount of lime it contains will make no difference. Your second experience is equally strange, and I can offer no explanation why a tinned iron tank should absorb more heat than a zinc one, unless your iron is very much stouter than the zinc. The only remedy I can suggest is to reduce size of tank, and use more packing.—Leghorn.

Bird-Cages.—Byker.—The articles on the above appeared in No. 54. Other small hints on the construction are given in "Shop."

¼ H.-P. Engine.—G. P. (*Camberwell*).—Articles are not run on in consecutive numbers of Work, but every series of articles is completed in the volume.

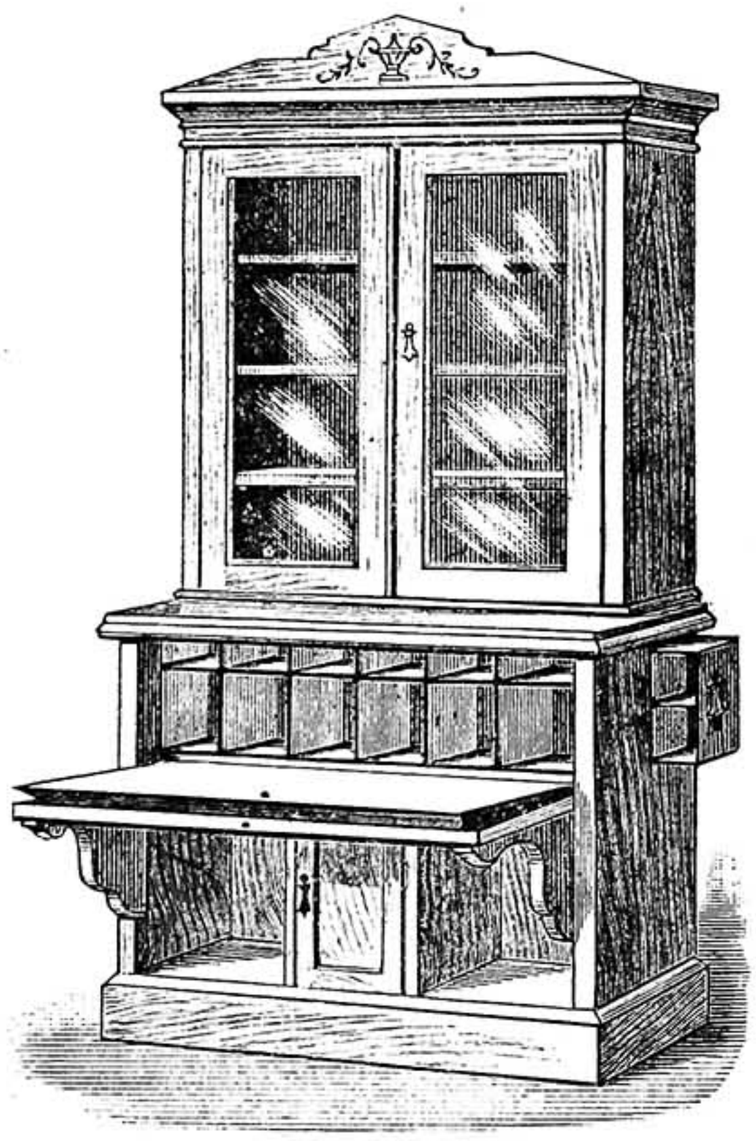
Fretwork Machine.—J. J. (*Fenton*).—Consult the Indexes of Work, Vols. I. and II. Much has already appeared upon Fretwork Machines.

Making Lantern Condensers and Objectives.—E. R. N. (*Forest Gate*) and others.—Read reply to F. J. D. (*Stoke Newington*), on page 219, and write again should any difficulty arise.—C. A. P.

Brooklet.—Admirer of "Work."—If you can get some strong blue clay, and make it into a puddle, and lay the bed of the stream 6 in. thick, I do not think many worms will get through. The puddled clay must be carefully laid, especially at the joins, which should be cut on each side with a 4 in. tool, the cuts filled with water, and well kneaded with a pair of heavy boots till in one mass. As an additional precaution, before laying on the puddled clay, cover the surface with slaked lime or soot. The clay should be pure and tough, and free from any admixture of stones, loam, or gravel. You will require about thirty-five cubic yards of clay if it is required the full length. If you cannot procure clay of this nature, lay a foundation of broken stones, 3 in. or 4 in. thick, and cover this with cement concrete 2½ in. thick, formed of five parts of crushed bricks or limestone and one part of Portland cement. Lay it in lengths of 6 ft., having boards laid to the proper shape at each end. In laying miss every alternate length, and when these are set fill in the spaces left, levelling them to the

work already done. When the concrete is laid in this manner, it is not so liable to crack as if laid straight on. The foundation should be well beaten down before laying on the concrete.—M.

Bookcase and Writing-Desk.—AMBIGITUR.—There are several varieties of bookcase, the lower portions of which can be immediately transformed into writing-desk, exposing pigeon-holes. The article I have designed follows the usual run of such things, with the exception that I have introduced one or two new, and I think serviceable, features. It is advisable to make it in two carcases screwed together. Of the top carcase, nothing further need be said than that sufficient instructions applicable thereto have appeared in past numbers. In the lower carcase there is a small bottom cupboard and a set of pigeon-holes enclosed by a flap-door, the latter being used as a writing-desk. To facilitate its use as such, it is intended that a bracket be hinged to the inside surface of each sideboard. Bookcases are generally made 18 in. deep from the wall. It will be seen, therefore, that if the front of the pigeon-holes are flush with the front of the job, difficulty would be

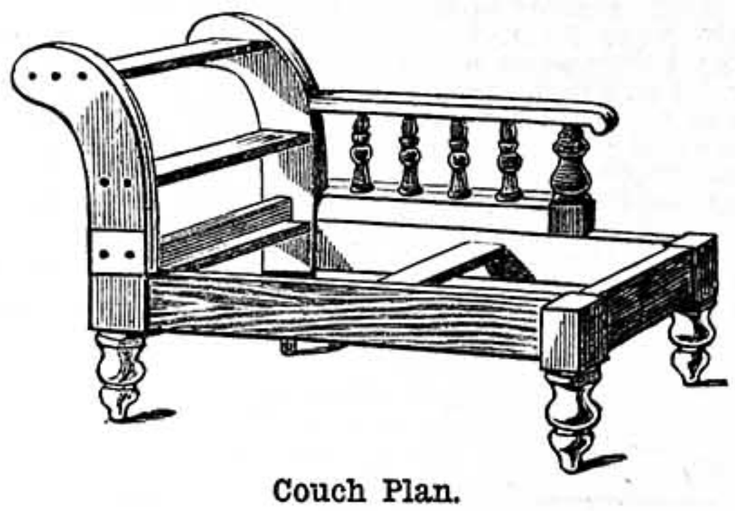


Bookcase and Writing-Desk.

experienced in obtaining any papers which happened to be far back in them. To avoid this, the front of pigeon-holes is usually some distance back, the result frequently being that the space in front of them is comparatively useless. By adopting my suggestion, all space will be utilised. Fit pigeon-holes as shown, and in back part of each sideboard cut hole to admit a set of compartments to move inwards and outwards drawer-wise, running on board to which front flap is hinged. It would be a handy course to take, also, to have a thin leather-covered board hinged at the back to the top surface of the writing-flap, with the ends closed in with loose material to form a receptacle for odd papers. For suitable details of construction, read Mr. Adamson's "Some Lessons from an Old Bureau," and other articles. Height of bottom carcase from floor, 3 ft. 8 in.; width of writing-flap, 12 in.; width of job, 3 ft. 6 in. Study dimensions a little, however. —J. S.

Batteries for Working Electro-Motors.—R. C. (*Mayfield*).—The cells of a battery to work an electro-motor should be large, because a large volume of current is needed to drive the machine, and this can only be safely taken from cells having a large capacity for furnishing a volume of current. Each cell should hold not less than one quart of liquid when the plates are immersed, but will be more efficient if made to hold half a gallon of liquid. The plates should be as large as the capacity of the cell, because large plates offer less resistance than small plates. In single fluid chromic acid or bichromate cells, two plates of carbon should have one plate of zinc between them in each cell. Large salt jars, pickle jars, or pickle bottles make very good single fluid cells. The charge for these is made up of 1 lb. of chromic acid and 2 ozs. of chlorate of potash dissolved in one quart of water, to which must be added, drop by drop, 7 fluid ozs. of sulphuric acid. The zinc must be well amalgamated, and should be thick. A good arrangement for the plates is shown on page 36, Vol. III., of WORK. The double fluid chromic acid battery, with dilute sulphuric acid to excite the zinc, and also the Bunsen battery, of similar construction, are both suitable for working electro-motors. See also reply to MAC, p. 93, Vol. III., of WORK.—G. E. B.

Couch.—J. N. (*Cork*).—A couch or lounge constructed like sketch would simply require framing together like a table frame. The legs should be turned out of 4 in. hard wood, and two of them kept about 4 in. longer than the others on the square; and the scrolls, which are made of 1¼ in. hard wood, are halved and screwed on to the squares. The rails across the scrolls are grooved in about ½ in. deep, and nailed from the outside. The back can be made first, and a stump at the end is framed into the seat rail, into which two flat rails are fitted to receive the turned spindles: the bottom one to be tenoned into the stump at one end and halved on to the scroll at the other end and screwed; the top one to go



Couch Plan.

on to the stump with a good 1 in. pin and halved into the scroll at the other end; this one receives the stuffing, and should be about 2½ in. wide. It will be seen in sketch that a middle rail or stretcher is put in to give strength; if the couch is short it will not be needed. Sizes: 4 ft. 6 in. long on frame, 20 in. wide; from bottom of leg to top of seat rail, 14 in.; height from floor to top of scroll, 2 ft. 8 in.; height of back from floor, 2 ft. 3 in. This is the size of a very short couch; you must use your own discretion about length, etc., as sizes vary to suit circumstances.—H. H.

Case for American Clock.—J. W. (*Kendal*).—I will leave you to decide upon the dimensions, thicknesses, etc. You cannot go far wrong in so small an article. As you are going to use a battery in addition to the small American clock, I advise you to place the former within the case, underneath the clock, if such a position is not unsuitable. Have a solid board, with a piece half circular in shape cut from it at the top, screwed within the case at the back to assist in supporting the clock. In the front of the case fix a similar piece, but let it be merely a frame, as in Fig. 2, to permit of the introduction of the battery, etc. You could, however, hang the clock within the interior by means of the ring above it. Fig. 2 explains the construction. It is an upright section. Two sides will be joined to a moulded top board, the bottom edges of them being rebated over stout plinth boards, the latter being mitred and screwed. A bottom board will be joined into the plinth pieces as shown. The back board should fit into rebates on those parts which it comes in contact with. The door can fit within the sides, or merely be hinged over their edges, as shown in Fig. 1; and it is an optional

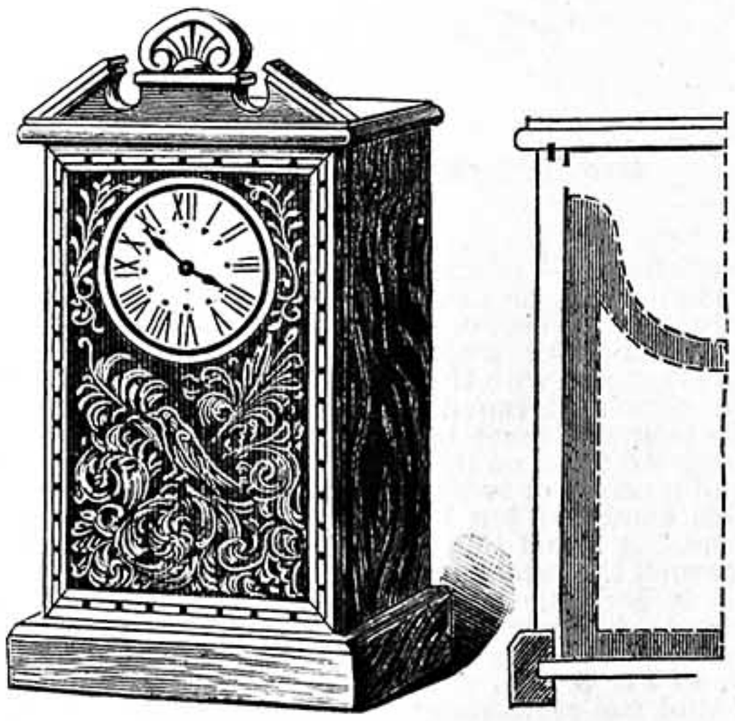


Fig. 1. Fig. 2.

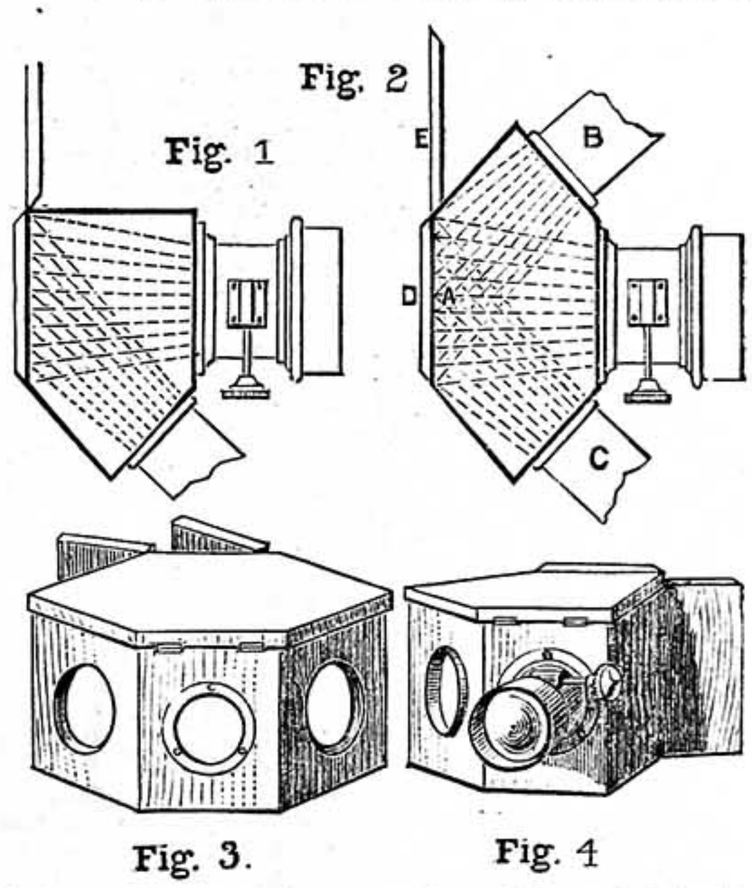
American Clock. Fig. 1.—The Case. Fig. 2.—Section of Case.

matter whether it is mitred or mortised and tenoned together. Rebate it to receive the glass, which should be left clear in the upper half to expose the clock face, and painted upon the lower portion. (See indexes for articles on glass painting, recently published in WORK.) The pediment will be merely glued and screwed to the carcase. Small brackets at the sides will be found useful and ornamental. In Vol. I. there appeared a design and copious details of a very pretty clock case in wood: see it for yourself if you do not already possess it. —J. S.

Aphengescope.—WELL-WISHER.—The aphengescope, megascope, or opaque lantern, as it is sometimes called, is a very interesting optical instrument used for the purpose of projecting enlarged images of opaque objects upon a lantern screen. The aphengescope, as illustrated in Figs. 1 and 4, is a sort of angular box made to fit on to the draw tube of the slide stage of an ordinary optical lantern in place of the objective, which is removed, and screwed into a flange attached to the front of the instrument, the object to be illuminated being placed in the body of the aphengescope facing the aperture by which the instrument is attached to the lantern. On the lantern being lighted, all the light emitted by the jet is concentrated full on the object by the condenser, and the achromatic lens in turn collects these rays and projects the image upon the screen in the usual manner, the lanterns, on account of the formation of the instrument, being placed with their backs towards the screen. The sole requirement of an aphengescope may be said to be: plenty of illumination, no matter from what direction it comes, so long as it is sufficiently powerful to brilliantly illuminate the object to be exhibited. As the loss of light by reflection is so great, the instrument will be found to be almost useless for use with an ordinary oil lantern, and even a single limelight jet is barely sufficient to give a disc of a larger diameter than about three or four feet, but by means of the double form of aphengescope shown in Figs. 2 and 3, and a

Fig. 1

Fig. 2



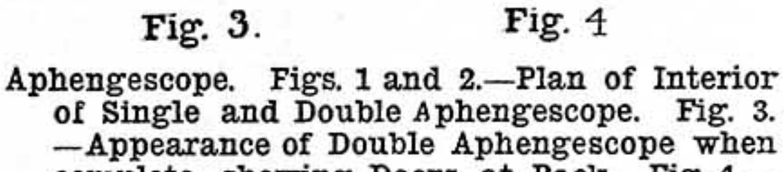


Fig. 3. Fig. 4

Aphengescope. Figs. 1 and 2.—Plan of Interior of Single and Double Aphengescope. Fig. 3.—Appearance of Double Aphengescope when complete, showing Doors at Back. Fig. 4.—Appearance of Single Aphengescope, with one Door shut.

biunial lantern, *which will take apart*, it is possible to show a well-lighted disc of about six or seven feet in diameter. The double aphengescope, which is of a slightly different form to the one previously described, is a wood or metal box, hexagonal in shape, and provided with circular apertures in three of its sides. A couple of these holes receive the lights from two lanterns, the objectives of which have been removed, and the third aperture, which occupies a central position between the other two at the front of the instrument, is provided with a metal flange to receive the objective from one of the lanterns, the objects to be exhibited being placed against the side of the box opposite to the lens. The construction of the double aphengescope is clearly shown in Fig. 2, in which it will be seen that the object placed at A is strongly illuminated by the light from the two lanterns, B and C, which are thus brought close together with their heads toward the screen, and a lantern objective is then screwed on to the front of the instrument in the same manner as if it was an ordinary lantern. Two doors, D and E, are so hinged to either side of the back that when one is open the other is shut; it will also be found an advantage to have the top and bottom of each door fitted with a narrow groove on the inside, as that will serve as a means of attachment for cartes-de-visite, allowing one to be slid into the grooves ready to be shown whilst the other is being exhibited. The dimensions of the instrument are immaterial so long as the principle is retained. You can therefore construct one of either form described above of suitable dimensions according to the objects you intend exhibiting; a useful size is one having the six sides about eight inches square. You can employ wood or metal in the construction of this instrument, but I should strongly advise you to make the body of good sound dry mahogany if you are a good hand at woodwork. The sides are nailed and glued to the base, which is formed of a piece of sound wood cut to the plan of Figs. 1 and 2. If formed of wood, you may with advantage fit and hinge a metal lid to open up towards the front, cutting the metal of a sufficient size to allow of a half-inch rim. A couple of narrow rings of brass tubing of sufficient size to just slip on to the draw tubes of the lantern fronts may be fitted into the

apertures cut in the woodwork at B and C, and then secured to the inner edge of the woodwork by means of nails or screws driven through holes punched or drilled in the metal. The door should be of wood, furnished with grooves at the top and bottom for the reception of cards as before described. For the objective, what is required is a lens of fairly long focus and large diameter, in order that it may pass plenty of light. The most suitable lens for this purpose will be a half-plate photographer's portrait combination. If your lantern, or lanterns, are fitted with ordinary achromatic combinations, one of these will be found to answer very well, but not so well as a half-plate portrait lens, for the reason above stated. To arrange the double form of instrument ready for use, the objectives are first removed from both the lanterns, which are then placed with their backs towards the screen. The aphengescope is now made to slide on to the draw tubes of the two lantern fronts by means of the couple of brass collars, after which one of the lantern objectives should be screwed on to the flange attached to the front of the instrument. If the photograph or other object to be shown by the reflected light emitted by the jet is placed against the back of the instrument immediately behind the objectives, and the lantern is lit up, the light emitted by the jets will illuminate the object, which is then projected by the lens in an enlarged form upon the screen, and instead of a transparent picture being shown upon the screen, we get a brilliantly illuminated representation of some solid, and perhaps moving, object. When any diagrams, drawings, or cartes-de-visite, are being shown, they are simply slipped into the grooved rails at the top and bottom of the two doors at the back of the instrument, and by this means one picture can be shown whilst another is being put in position upon the other door ready to take the place of the first. Other objects are either held in the hand of the operator, or placed upon the floor of the instrument. The objectives will, of course, require focussing in the usual manner. The aphengescope will be found very useful to microscopists, who will thus be enabled to show upon the screen various opaque objects which it would be impossible to exhibit by ordinary means. The works of a watch, coins and medals, sections of various kinds of fruit, shells, shell fish, moths, butterflies, minerals, and, in short, anything that cannot be photographed, or which should be shown in its natural colours, will form a suitable subject for exhibition by means of the aphengescope.—C. A. P.

Backstay.—R. W. M. (*Co. Kildare*).—To prevent work from chattering when thin and turned between centres, you require what is called a *backstay:* these are of two kinds, the *fixed* and the *travelling*, which latter moves along with the tool, whilst the first is fixed to the bed, and is moved along, as you suppose, "as work proceeds." As I think the backstay has not been mentioned before in WORK, and as you will be able very easily to fit up for yourself this useful attachment, I will describe one or two kinds of fixed stays. To steady the work when turning ramrods, I believe the turner uses nothing but the fingers of his left hand; I have never seen this done, and could not do it myself, but I can fancy it would be possible. The next simplest way is to make a notch in a bit of board like Fig. 1, and fix it in between the shears with wedges. You see it is a very simple matter when all you require is to steady a long piece of wood, such as a wicket, etc. The wood smokes and gets blackened where it rubs against the notch, and shows you the possibility of making fire, as the Indians do, by rubbing two pieces of wood together; you would, of course, put some grease to it. The piece of wood (A) and the wedges may be from ¾ in. to 1 in. thick; the V-notch can be brought forwards by knocking up the wedge (B) and down the wedge (C). In Fig. 2 you have a better plan which, I think, would suit you well for wood. Here A is a piece of hard wood, such as oak, about 1 in. thick; B is a wedge, passing through a mortise, by means of which A is held firmly down upon the lathe-bed: through the upper end of A there passes a bolt, and by its means is secured a plate of iron about ¼ in. thick, having at one end a V-notch, and at the other a slightly elongated hole for the bolt. The bracket of wood (A) being placed on the bed and secured by the wedge (B), the plate (C) is turned over so as to rest its fork upon a turned part of the work to be steadied; then the bolt is fixed, and after applying a little grease you may go ahead. In Figs. 3 and 4 is seen a plan which may be adopted by those who have a little bracket like A A, which is used to support the boring collar, and supplied with complete lathes; here we dispense with the wooden support, and require only two plates with notches, the united thickness of which will about equal that of the boring collar. Figs. 5, 6, and 7 show a plan contrived (but never carried out) when intending to turn a number of ¼ in. spindles of rosewood about 7 in. long; it was, however, found quite possible to do without any support; yet the plan looks promising for very small work, and it is herewith presented to the readers of WORK. A new T is required for the rest, seen sideways at Fig. 5; this only differs from the usual form in having the upper edge thicker, so that a $\frac{5}{16}$ in. hole (A), shown black, can be drilled and tapped into both ends; then two little pieces of steel would be made like Fig. 6, about 1½ in. long, and a $\frac{3}{16}$ in. screw (B, Fig. 7) provided to fix them. The view at Fig. 7 will suffice, instead of further description; the first 2 or 3 inches of the work are turned without any steadying appliance; then the screw (B) is put into the end of the rest, the little plates with their V-notches slipped into it, clasped by the fingers into the turned part, the screw fixed, and all is ready to turn 2 or 3 inches more. Thus far we have dealt with fixed backstays, which are secured to the bed; but you have a slide-rest, and would probably like to know how to fit one into the slide-rest itself, so that it may hold the work close up to the tool. This will be still a *fixed* stay, as it does not follow with the tool, keeping the same distance from it, but is fixed to the lower slide of a slide-rest, and not upon a moving saddle as on a slide lathe. Figs. 8 and 9 show a side and back view of a slide-rest backstay that has just been made to my design by Mr. Chas. Taylor, of Bartholomew Street, Birmingham; it fits one of his 3½ in. slide rests, and I have put into Fig. 8 a few lines to represent a slide-rest, just to show how the backstay fits on. Here we have the same two notched plates (A and B), but as we are now dealing with metal turning they will require holding very firmly: C C is a casting which slips into the cross-slide of the rest, and is secured by pinching the screws D, D; A B are then adjusted, the nut E firmly fixed, clamping the forked sides of the bracket C upon the plates A and B. The appliance is very quickly put in position, and as quickly removed. The plates A, B, are of iron, case-hardened. The travelling backstay is usually made to fix upon the saddle, as this one does on the fixed slide-rest; it is generally made to take two wooden dies, by means of which the work is steadied; of course, wood does not mark or scratch the work, but then the wood dies must be made and adjusted.—F. A. M.

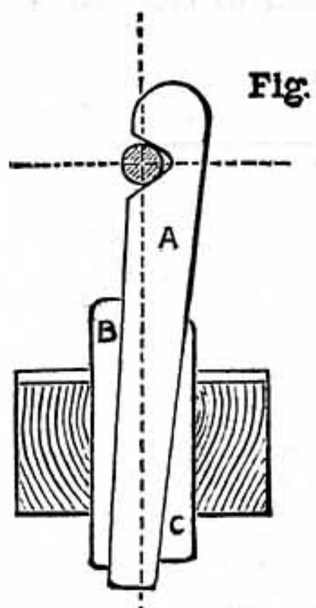


Fig. 1.

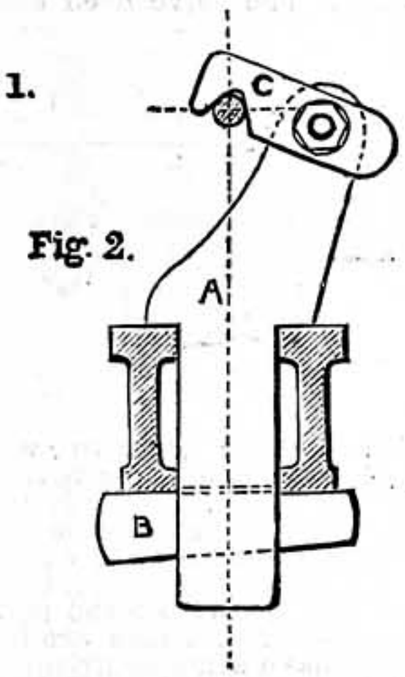


Fig. 2.

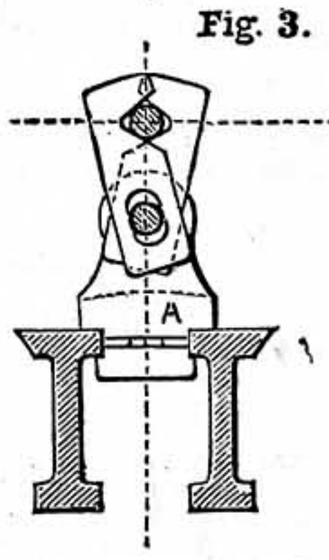


Fig. 3.

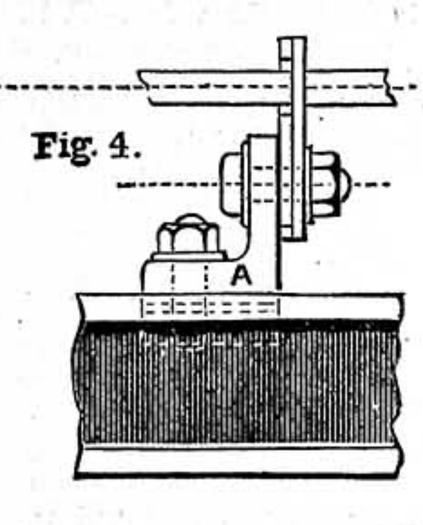


Fig. 4.

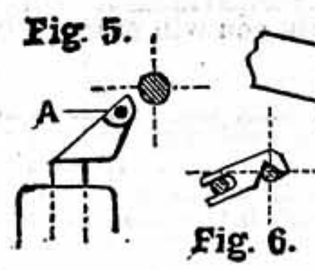


Fig. 5.

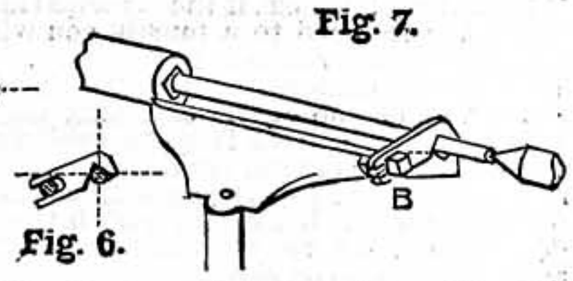


Fig. 7.

Fig. 6.

Backstay. Fig. 1.—Simple Backstay. Fig. 2.—Better Form. Figs. 3, 4.—Stay for Slender Turning fixed to Boring Collar Support. Figs. 5, 6, 7.—Proposed Form of Stay for Slender Turning. Fig. 8.—Side View. Fig. 9.—Back View.

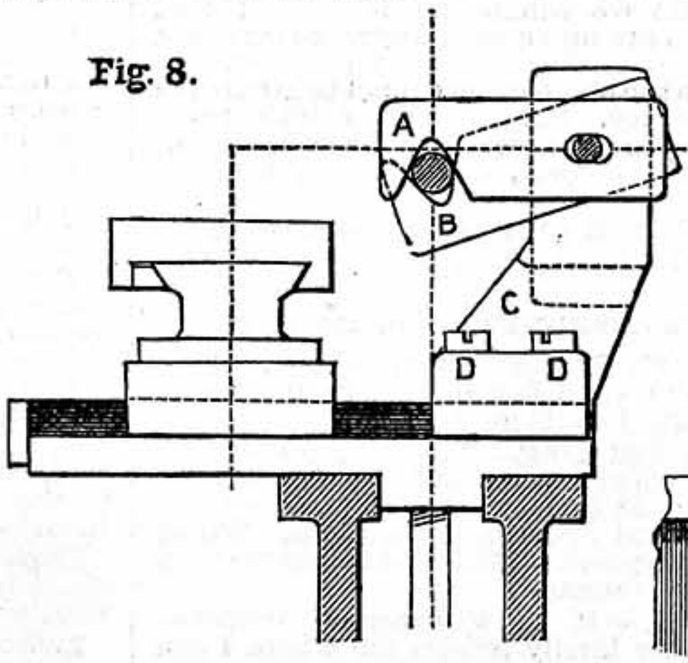


Fig. 8.

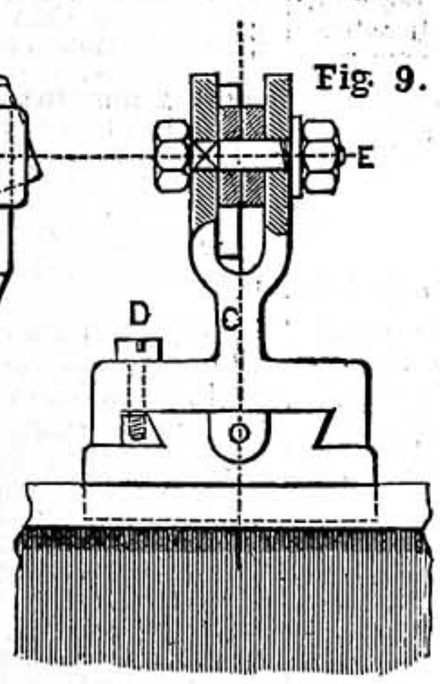


Fig. 9.

Paper Staining. — DOWN. — Paper-stainers' colours are prepared much after the way of decorators' distemper. The firms purchase their colours in dry powder form—blue, red, yellow, etc., of varying degrees of purity and brightness. Whiting of a fine quality forms the body for the bulk of paperhangings, excepting, of course, sanitaries and so-called washable papers. Read the chapter on Distemper in "Plain and Decorative House Painting," Vol. I.—F. P.

Varnish.—J. B. (*Durham*).—Varnish prepared from shellac and methylated spirit, or of similar nature, such as French polishers use, is about the only variety that can be successfully made by the individual worker. If your query refers to painters' copal-oil varnish, you may at once dismiss the notion of making it from your mind.—F. P.

Painting Bird Cage.—BIRD FANCIER.—The reason of the enamel paints you have used on the inside of bird cages not drying is probably due to greasiness of the cage, or the enamel may be stale, or else you have put too much on, and it is only surface-dry, and not hard throughout. I would advise—assuming they are wire and metal cages—that you give a first coating of flatting paint made with white lead, or zinc white, and diluted to working consistency with two parts turps to one of Japan gold size. This will form a good ground or "key" for enamel, and if it does not then harden, the enamel is at fault. Ordinary patent size is the cheapest thing to prepare wood for staining with. It raises the grain of the wood slightly, but answers well for all common staining, and prevents the sappy parts becoming darker than the remainder. If best effects are wanted, varnish or Japan gold size may be used instead of size before oil staining.—F. P.

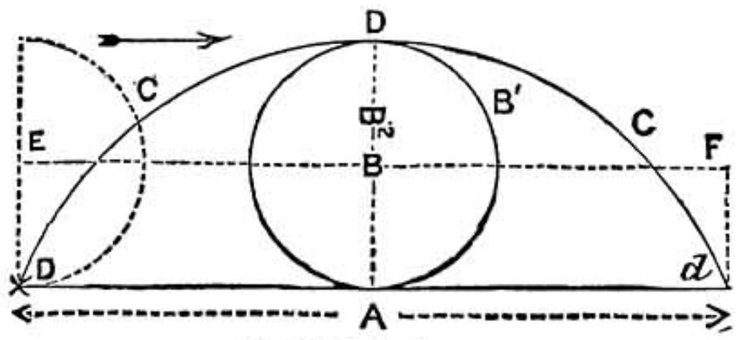
Colouring Kitchen.—D. P. V. (*London, S.E.*).—Ordinary wall colouring or distemper is prepared from size and whiting; the addition of dry powdered pigments gives the tints. For yellow, or rather buff, wall colour, soak 14 lbs. of whiting in sufficient water to slacken it, putting the whiting into the water. Pour off superfluous fluid, and add the colouring powder—Venetian red for pinks, lime blue for grey or light blue, and ochre for buff. These used separately, or in mixtures, will give a great variety of tints for common purposes. Having well mixed in the colouring, try a little by drying on paper, and when the desired tint is obtained, add to the above four pounds of warm patent size, or about one pound of glue properly dissolved. Before following these directions, obtain the new circular, etc., of Alabastine, from the Church Manufacturing Company, 127, Pomeroy Street, S.E.—F. P.

Bicycle Wheel.—PARALLAX.—(1) The wheel is out of truth, and requires to be trued up. If the spokes are direct, procure a spoke grip, costing about 1s. 6d.; if laced or tangent, procure a nipple key, costing 1s. Revolve the wheel, holding a piece of chalk at the side of the rim. The rim will touch the chalk at the parts out of truth. Tighten all the spokes on the *opposite* side of the chalk marks if they are loose. If they are tight, slacken all the spokes *on* the side of the chalk marks. Wipe off the chalk with a rag, and revolve wheel again, letting the untrue parts touch the chalk as before. Continue slackening spokes at the marks on the chalk side, and tightening on the opposite side. If you are not equal to performing this bit of work, send the machine out to a qualified repairer. (2) Cement for fastening tires can be bought at the cycle shop for 9d. to 1s. per pound, or in 6d. boxes, so that it is not worth anybody's while making it, even though he knew how.—A. S. P.

Picture Cords.—T. W. M. (*Burslem*).—The plan sent us, so far as we can see, is novel and useful, as well as ingenious, and certainly worth patenting, as it would answer its purpose well, besides being simple and ornamental. We think our correspondent would not be acting wisely if he did not turn it to some account, there being nothing to gain by giving it away, and letting others reap the benefit of that which he is clearly entitled to, as the product of his own inventive ingenuity. We should strongly advise him to make a search at the Patent Office Library to ascertain all that has been done in this direction, so as to see his road clear, and, if so, to go ahead with his patent.—C. E.

Speed of a Wheel.—C. C. (*New Cross, S.E.*).—The great difficulty in making ordinary people understand the fact that the upper part of a wheel of a cart, cab, omnibus, carriage, or locomotive, is travelling faster than the lower part, when either is in motion, arises from their being unable to dissociate their ideas from the case of a wheel fixed on a shaft or axle, which shaft or axle revolves in a fixed or stationary bearing, like the

fly-wheel of a steam, gas, or other engine used in driving machinery. In this case the wheel revolves with equal velocity over all its circumference, but the moment this wheel and its axle and bearing are caused to travel along a surface, another set of conditions come into play which did not exist in the former case, and then a compound movement takes place. First the wheel or shaft, or axle and bearing, travel along a surface, and whilst the axle and bearing travel in a line parallel to that surface over a distance equal to the circumference of the wheel, a point in the revolving wheel is describing, by the motion of its circumference, a curved line which is longer than the path travelled by the axle and bearing. Therefore, it must follow that to travel the same distance in the same time, a spot on the wheel must have travelled faster than the axle and bearing, to have described the curve which is a longer distance than the axle and bearing travel, and come again to the similar spot over the surface from which it started, in the same time. In order that this may be easily seen, we have appended the following diagram, a little study of which will make this clear and apparent to anyone. In this diagram the cycloidal path of a given point on the circumference of the wheel, starting from the surface on which it rests until it comes again over a point on the surface from which it started, may be readily seen, and if a model wheel be made of, say, 6 in. in diameter, and a piece of wood or board of, say, 2 ft. long be used as the surface on and along which it is rolled, it will be seen and proved that a complete revolution of the wheel will bring the point on the wheel, which was over the surface at starting, over another point of the surface at a distance equal to the circumference of the wheel from the point where it was when it started, but that to get there it must have travelled along the curved line, which is always longer than a straight line between two given points, at a faster rate to do a longer distance in the same time. In the diagram, the line A represents the

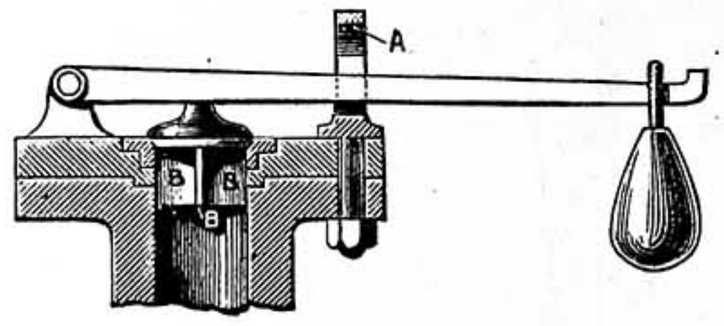


Cycloidal Curve.

distance over which the wheel has to travel, the axle moving from E to F on the dotted line. The dotted wheel shows the position of the spot D on its circumference at starting; C C shows the curved path of the spots travelled by it until it comes to a similar position on the surface at *d*, having travelled from left to right, as shown by the arrow; B shows the position of the axle, and B' that of the wheel, when they have completed one-half of their journey, the spot D being now at the top of the wheel, having ascended the rising half of the curve. As it goes on, it describes the falling curve to *d*, where it again resumes the same position in regard to the surface as it had at starting, and so long as the wheel travels, so this spot will always continue to perform the same thing. Anyone who has watched the wheel of a hansom cab when at speed, can hardly have failed to notice how the centrifugal force throws the mud and dirt from the top, and not the bottom, of the wheel, which could not be the case if the lower part travelled with equal velocity. The formula for the diagram is as follows:—Length of the base line A=3·14159 B^2; B^2 the generating circle = ·31831 A; length of curve C C=4·B^2.—C. E.

Polish Reviver.—A. E. S. (*London*).—I am always chary about recommending to inexperienced hands any reviver containing methylated spirits or naphtha. I can well recall to mind ten years ago selling a bottle of reviver, the chief ingredient of which was spirits; my customer had a valuable piano, on which she first tried her 'prentice hand, thinking that the more liberally she used the reviver the better the results would be. Alas! this mistaken idea nearly spoiled, instead of improved, the polish. This incident, though it found me a day's work to rectify the damage, etc., serves to show that, though experienced hands can use such revivers with advantage, it is well to warn the inexperienced to use anything containing spirits with caution, and I strongly recommend using the spirits in the finishing rather than the cleaning stage, as in the following recipe, which I have used almost daily for the last four years—so giving a fair trial, and for the purpose you name: viz., "keeping your recently polished bookcase in a bright and fresh condition"—and which will, I trust, do all you might desire. Reviver: ½ pint lime-water, ¼ pint linseed oil, ¼ pint sweet oil, ¼ pint turpentine. Mix the lime-water and linseed oil by well shaking, then add the sweet oil; when thoroughly incorporated, thin down with turps. Shake up when using, and apply, rather liberally, with wadding or soft rag, rubbing all over; wipe off with a soft rag, fairly damp with methylated spirits, changing the face of the rag occasionally to enable you the better to remove all greasiness and smears. You may then, if you like, touch up any carvings or mouldings with a little French polish or spirit varnish, applied with a camel-hair brush.—LIFEBOAT.

Valve.—E. F. (*St. James's*).—In any well-designed safety-valve, the valve should not be able to be removed from its seat without, as you remark, first removing the pin in the end of the lever. In order to prevent the valve being blown out of its seat, there is generally a guide for the lever which allows it to lift sufficiently for the proper escape of the steam through the valve, and is then stopped by the top of the slotted guide A, which can be seen in the accompanying sketch of an ordinary safety-valve. The valve itself should be provided with



Valve.

three or four wings (B), which guide it vertically and prevent it being blown sideways by the escaping steam. This is the commonest form of safety-valve; and some are made without the guide (A), but very few indeed, in which case, by swinging the lever over, the valve can be removed without taking out the pin. The various spring safety-valves, which are innumerable, almost always have some contrivance to prevent the blowing out of the valve.—P. B. H.

Walking-Sticks.—E. H. (*Sunderland*).—The following are addresses of makers and carvers of walking-sticks: Henry Howell & Co., 180, Old Street, London, E.C.; J. Slugg, 27, St. John's Road, Hoxton, London, N.—H. W.

Model Electric Lights.—T. T. (*Harlesden, N.W.*).—Consult the Indexes to Vols. I. and II. of WORK.

Camera.—G. M. F. (*Falmouth*) will find in WORK, Vol. I., full particulars for constructing a whole-plate camera from one of the best makers' designs—that of George Hare. Every maker in the present day introduces some variation in pattern or movements—many of which are unnecessary, and only add to the complications of the instrument, which cannot be too simple, provided the really useful movements are retained. With regard to the quarter-plate size, if the principal measurements given are reduced to a fourth, you will practically have all the information you require. Of course, in such a small camera the woodwork may be made lighter, and some of the clamping neglected. The length of the bellows is quite arbitrary, so long as the length is sufficient for the lens used. It is quite impracticable to supply you with working drawings for any camera. If Underwood's is the one you have decided on, we see no other way out of the difficulty than that you should procure one and copy it. As to the lens, so much depends on the kind of work you intend doing. The best plan is to be provided with several of different focal lengths. If you are limited to one, there is nothing better than Dallmeyer's rapid rectilinear lens, of 6 in. focus; and the next most useful is a Ross symmetrical, of 3 in. focus. There are now so many good lenses in the market that we cannot particularise them; those mentioned are universally approved standard instruments, and if they are used properly, any shortcomings in the photograph cannot be attributed to their inefficiency. For *interiors* a wide angle rectilinear is almost necessary, other kinds not including enough subject, especially in confined spaces.—D.

Xylonite.—G. A. B. (*Normanton*).—Write to the manufacturers for their prices.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Wood-Turner's Pattern Book.—T. F. (*Aberdeen*) writes:—"I shall feel obliged if any reader will tell me where I could get this."

Crystoleum Painting.—PAINT-BRUSH writes:—"I find that when a photo is fixed on the glass with corn-flour paste, that three out of four times it shrinks away and puckers at the edges. Would any of your correspondents tell me another medium I can use to do the same?"

Buff Leather.—R. S. (*Gloucester*) writes:—"Will any reader kindly inform me where I can get buff leather such as soldiers' belts are made of, with price per pound?"

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—EDISON PHONOGRAPH CO.; HOPEFUL; F. J. (*Rochdale*); W. R. R. (*Carlisle*); A. F. (*Dublin*); YOUNG ENGINE DRIVER; N. D. P. (*Manningham*); M. G. H. (*Smethwick*); J. T. (*Rawtenstall*); G. A. H. (*Islington, N.*); LITHO; A. R. (*Scorrier*); B. C. E. (*Birmingham*); E. L. C. (*Portland*); J. B. W. (*Salford*); W. G. C. (*Sierra Leone*); G. P. (*Gloucester*); INVENTOR; J. W. H. (*Chesterfield*); J. E. P. (*Accrington*); GOOD IRON; POLISHER; W. C. R. (*Glasgow*); J. G. (*Edinburgh*); W. J. (*No Address*); W. J. (*Portsea*); AMATEUR MECHANIC; J. D. (*Hull*); C. F. (*Sherborne*); BOOKWORM; L. S. (*Beaverstown*); SELF-HELPER; W. T. (*Stratford-on-Avon*); F. P. (*Dover*); T. S. (*Manchester*); W. B. & SONS (*Edinburgh*); J. P. A. (*Walthamstow*); G. M. (*London, E.C.*); H. B. (*East Hartlepool*); E. W. (*Chingford*); M. G. B. (*Poplar*); AN OLD EDISONIAN; A PLAYER; LEMUR; F. W. R. (*South Shields*); HOUSE PAINTER; S. A. (*Burnley*); R. C. (*Mayfield*); J. H. (*Cork*); NERO; A CONSTANT READER; T. R. (*Ashton-le-Willows*).

MANUALS OF TECHNOLOGY.

Edited by Prof. AYRTON, F.R.S., and RICHARD WORMELL, D.Sc., M.A.

The Dyeing of Textile Fabrics. By J. J. HUMMEL, F.C.S., Professor and Director of the Dyeing Department of the Yorkshire College, Leeds. With Numerous Diagrams. Seventh Thousand. 5s.

Steel and Iron. By WILLIAM HENRY GREENWOOD, F.C.S., M.I.M.E., etc. With 97 Diagrams from Original Working Drawings. Fifth Edition. 5s.

Spinning Woollen and Worsted. By W. S. BRIGHT MCLAREN, M.P., Worsted Spinner. With 69 Diagrams. Second Edition. 4s. 6d.

Cutting Tools. By Prof. H. R. SMITH, Professor of Mechanical Engineering, Sir Joseph Mason's College, Birmingham. With 14 Folding Plates and 51 Woodcuts. Third Edition. 3s. 6d.

Practical Mechanics. By J. PERRY, M.E., Professor of Mechanical Engineering, City and Guilds of London Technical College, Finsbury. With Numerous Illustrations. Third Edition. 3s. 6d.

Design in Textile Fabrics. By T. R. ASHENHURST, Head Master, Textile Department, Bradford Technical College. With 10 Coloured Plates and 106 Diagrams. Third Edition. 4s. 6d.

Watch and Clock Making. By D. GLASGOW, Vice-President, British Horological Institute. Second Edition. 4s. 6d.

CASSELL & COMPANY, LIMITED, *Ludgate Hill, London.*

WORK

is published at La Belle Sauvage, Ludgate Hill, London, at 9 o'clock every Wednesday morning, and should be obtainable everywhere throughout the United Kingdom on Friday at the latest.

TERMS OF SUBSCRIPTION.

3 months, free by post	..	..	1s. 8d.
6 months, "	..	..	3s. 3d.
12 months, "	..	..	6s. 6d.

Postal Orders or Post Office Orders payable at the General Post Office, London, to CASSELL and COMPANY, Limited.

TERMS FOR THE INSERTION OF ADVERTISEMENTS IN EACH WEEKLY ISSUE.

	£	s.	d.
One Page	12	0	0
Half Page	6	10	0
Quarter Page	3	12	6
Eighth of a Page	1	17	6
One-Sixteenth of a Page	1	0	0
In Column, per inch	0	10	0

Small prepaid Advertisements, such as Situations Wanted and Exchange, Twenty Words or less, One Shilling, and One Penny per Word extra if over Twenty. ALL OTHER Advertisements in Sale and Exchange Column are charged One Shilling per Line (averaging eight words).

Prominent Positions, or a series of insertions, by special arrangement.

*** Advertisements should reach the Office fourteen days in advance of the date of issue.

SALE AND EXCHANGE.

Victor Cycle Co., Grimsby, sell Mail Cart Wheels. [7 R

Who's Lunt?—Why, the Best Man for Joiners' Tools, of warranted quality. Send stamp for our Seventh Edition Reduced Price List.—LUNT, Tool Merchant, 297, Hackney Road, London, E. [9 R

The Universal Amateur Exchange.—Electrical, Optical, Mechanical, Chemical, Photographic, etc. Established 1862. Catalogues, 2d.—A. CAPLATZI, Chenies Street, Bedford Square. [18 K

The Buyers' Guide to Books on Mechanical Subjects, by English and American Authors, 6d. The best book on Lathe, with chapters on Screw-cutting, Metal-spinning, 3s.; soiled copies, 2s. The latest and most complete Treatise on Screws of every kind, with numerous illustrations. English, American, Swiss, and French Threads, 3s.; soiled copies, 2s. Above are published and sold by BRITANNIA Co., Tool Makers, Colchester, and sent post free. [19 E

Turning Classes or Turning Lessons.—Those who would be willing to conduct evening classes; also those who can give instruction at their own house, are requested to forward their address, stating which they can undertake—BRITANNIA Co., Colchester. Technical schools and workshops fitted up complete with tools, engines, shafting, etc. [20 K

Model Ships' Fittings, Model Engines, etc.—Catalogue, 70 illustrations, 4d.—STIFFIN & Co., 324, Essex Road, London, N. [1 S

Paper Letters, Rubber Stamps, etc.—Agents should apply for samples (free).—WILLCOX BROTHERS, 172, Blackfriars Road, London, S.E. [2 S

Lettering and Sign-Writing made Easy.—Also full-size diagrams for marking out eight alphabets, only 1s. — F. COULTHARD, Darlington Street, Bath. Note.—100 Decorators' Stencils (60 large sheets), 2s. 6d.

Fret, Carving, and Repoussé Patterns.—100 of either, full-size, 1s.; 300 Turning Designs, 1s.; 400 small Stencils, 1s.; 500 Shields, Monograms, &c., 1s., postage free.—F. COULTHARD, Darlington Street, Bath (late Bournemouth). [3 S

Alberts, white metal all through; warranted; 1s. 3d. post free.—K. HEAP, Castle Street, Southport. [4 S

Cricket Tackle.—Bargains; must sell. Four splendid all cane-handled match bats, grand driving blades, and worth 13s. each, price 7s. each; two best balls, 3s. 9d. each; set polished stumps, 4s. 9d.; pair leather wicket gloves, 3s. 6d.; pair batting gloves, 4s. 6d.; pair leg guards, 5s. 6d.; and handsome guinea Marylebone cricket bag, 10s. 6d., or if all taken, will accept £3 3s. All quite new, and approval before purchase.—SECRETARY, Bloemfontein House, Shepherd's Bush, London. [5 S